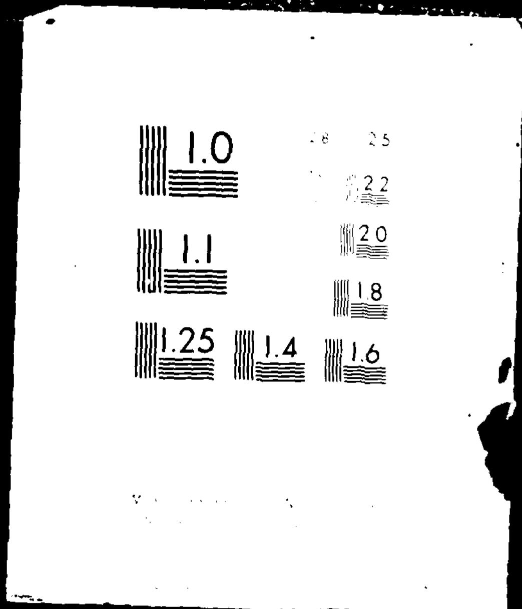
AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)
SEP 81 F04704-80-C-0006
UNCLASSIFIED E-TR-53-2 NL

1 OF 3
AD A
112959

1 OF 3

AD A
112959



E-TR-53

PHOTOGRAPH THIS SHEET

III

LEVEL

1

INVENTORY

DTIC ACCESSION NUMBER

E-TR-53-II

DOCUMENT IDENTIFICATION

This document has been approved for public release and sale; its distribution is unlimited.

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	☒
DTIC	TAB	☐
UNANNOUNCED		☐
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A		

DTIC COPY INSPECTED 3

DISTRIBUTION STAMP

DTIC
APR 0 5 1982
E

DATE ACCESSIONED

DATE RECEIVED IN DTIC

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDA-2

DTIC FORM OCT 79 70A

DOCUMENT PROCESSING SHEET

Ertec

The Earth Technology Corporation

MX SITING INVESTIGATION
WATER RESOURCES PROGRAM
REVIEW DRAFT
WATER APPROPRIATIONS HEARING
PRESENTATION AND SUPPORT
DOCUMENTATION

DRY LAKE VALLEY, NEVADA

VOLUME II

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

30 September 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER E-TR-53-II	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Water Resources Program Review Draft Water Appropriations Hearing Presentation + Support Documentation Dry Lake Valley, NV Vol. II		5. TYPE OF REPORT & PERIOD COVERED Draft
		6. PERFORMING ORG. REPORT NUMBER E-TR-53-II
7. AUTHOR(s) Ertec		8. CONTRACT OR GRANT NUMBER(s) F04704-80-C-0006
9. PERFORMING ORGANIZATION NAME AND ADDRESS Ertec Western Inc. (formerly Fugro National) P.O. Box 7765 Long Beach Ca 90807		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 64312 F
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Department of the Air Force Space and Missile Systems Organization Norton AFB Ca 92409 (SAMSO)		12. REPORT DATE 30 Sep 81
		13. NUMBER OF PAGES 62
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) Distribution Unlimited		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Well logs, Well Design, Gravity Surveys,		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) this report represents integration of two years of intensive MX Water Resources Program activities in NV-UT siting area		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

LIST OF APPENDICES

A1.0

DRY LAKE VALLEY SECTION: MX SITING INVESTIGATION, WATER MANAGEMENT REPORT

4.5 DRY LAKE VALLEY

4.5.1 Hydrologic Summary

Dry Lake Valley is a topographically open basin in Lincoln County, Nevada. Of the approximately 700 mi^2 (1813 km^2) of valley area, 310 mi^2 (802.9 km^2) are suitable for MX deployment (Table 4-10).

Dry Lake Valley is hydrologically connected with Muleshoe Valley, and the two valleys are considered as a single hydrographic unit by the Nevada State Engineer. Ground water in Dry Lake and Muleshoe valleys is essentially undeveloped, however, there are 20 acre-ft/yr (0.02 hm^3/yr) of pending applications and 19 acre-ft/yr (0.02 hm^3/yr) of certificated or permitted rights (Woodburn and others, 1981) for ground-water withdrawal. In addition, there is 21 acre-ft/yr (0.02 hm^3/yr) of surface water use (DRI, 1980) in the valley.

The perennial yield is estimated at 3000 acre-ft/yr (3.70 hm^3/yr) for the Dry Lake-Muleshoe basin (State of Nevada, 1971). The combined peak-year MX water requirements in the two valleys, 3373 acre-ft/yr (4.16 hm^3/yr) for Dry Lake and 968 acre-ft/yr (1.19 hm^3/yr) for Muleshoe, in 1984 would exceed the Dry Lake-Muleshoe basin perennial yield by 1341 acre-feet (1.65 hm^3). However, the combined total ground water in storage within the upper 100 feet (30 m) of saturated sediments in Dry Lake and Muleshoe valleys is estimated at 2.8 million acre-feet (3452.4 hm^3) (State of Nevada, 1971). This suggests that the ground-water basin could sustain the peak MX water demand if temporary overdraft is allowed by the Nevada State Engineer.

GENERAL PHYSIOGRAPHY

Valley Area	Valley Length	Avg. Valley Width	Suitable Area	Avg. Valley Floor Elevation
700 sq mi	38 mi	18 mi	310 sq mi	4800 ft

GENERAL HYDROLOGY

Aquifer	Depth to Water	Potentiometric Elevation Range	Transmissivity	Storativity
Valley-fill	300-800 ft	4200-5000 ft	3300 sq ft/day	0.06
Carbonate	850 ft	_	13,000 sq ft/day	-

Perennial Yield	Ground-Water Recharge (ppt)	Interbasin Recharge	Interbasin Discharge	ET	Surface Discharge
3000	2700	2100	5000	minor	-

WATER QUALITY

Total Samples	Suitable for Consumption	Exceeds (1) Standards	Suitable for Construction	Exceeds * Standards
6	5	1	6	0

WATER USE AND APPROPRIATIONS (2)

Source	Current Use	Applications	Certificates/ Proofs/Permits	Availability (3)
Ground Water	0	20	19	3000/2981
Surface Water	21	2596	-	-

MX WATER REQUIREMENTS

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Construction Operation	196	414	3373	2458	2014	225	0	0	0

(1): Well near Bristol Silver Mine - exceeds state primary standard for nitrate
(2): Dry Lake and Muleshoe valleys combined
(3): Perennial Yield - Current Use / Perennial Yield - Certificated Use
* : Portland Cement Association recommendations (1966).

Note: All units are in acre-feet per year unless otherwise noted.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

HYDROLOGIC SUMMARY
DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4-10

Surface water supplies are limited to ephemeral streamflow and springs. The springs are located mostly in the mountains, are generally unaccessible, and have low discharge (less than 2 gpm [0.13 l/s]).

A 10-day aquifer pump test conducted by Ertec in the southern part of the valley (3S-64E-12ca) (number 40433) indicates a generally unconfined valley-fill aquifer having an average transmissivity of 3300 ft^2/day (306.6 m^2/day) and a storativity of 0.06. Confined or semiconfined conditions are, however, expected in other portions of the valley due to the complex nature of the valley fill which was found to be composed of variable thicknesses of clay, silt, sand, and gravel.

The regional carbonate aquifer underlying and adjacent to the valley fill is considered to have a high potential for development. Data from an aquifer test performed by Ertec in the northern part of the valley (3N-63E-27cc) indicate a transmissivity in the carbonate aquifer of 13,000 ft^2/day (1208 m^2/day). The test well was pumped at a sustained rate of 106 gpm (7 l/s) with a drawdown of only 2 feet (0.6 m). The hydrostratigraphic unit (Guilmette Formation and Simonson Dolomite) penetrated at the test site is considered to be a high-yield aquifer based on these investigations.

Water-chemistry tests on water samples collected by Ertec from both the valley-fill and carbonate aquifers show that all but one well, 3N-65E-21dba, meet primary and secondary drinking

water standards for the State of Nevada (Appendix D). This well, located in the northeastern part of Dry Lake Valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l standard for nitrate. This well was, however, used for mining operations by the Bristol Silver Mine and is thought to be contaminated by mining-related activity.

4.5.2 Water-Supply Sources

Development of the valley-fill aquifer is the preferred source for the MX water supply in Dry Lake Valley (Table 4-11). Development of the valley-fill aquifer is projected to have the least potential impact on local water users and the environment, the highest physical development potential, and to be the least costly and the most timely to develop of the four water-supply options. The legal availability of ground water from the valley-fill aquifer was ranked second to importation because the estimated perennial yield of the hydrographic basin can supply only about 70 percent of the peak-year requirements. The quantity of ground water presently available for development, based on certificated and permitted water rights, is 2981 acre-ft/yr (3.68 hm^3/yr). The estimated combined peak-year water requirement for Dry Lake and Muleshoe valleys is 4341 acre-feet (5.35 hm^3) during 1984. However, there is essentially no ground-water use in Dry Lake Valley, and the State Engineer need not limit his decisions on the approval of ground-water applications to a comparison of approved water rights versus the perennial yield of the basin. Quantity, distribution, and type and length of

Criteria	Weight	Valley-fill Aquifer Score	Valley-fill Aquifer Wt. Score	Carbonate Aquifer Score	Carbonate Aquifer Wt. Score	Lease/ Purchase Score	Lease/ Purchase Wt. Score	Importation Score	Importation Wt. Score
Legal Water Availability	10	7	70	7	70	0	0	8	80
Impacts on Man or Environment	10	9	90	8	80	7	70	6	60
Development Potential (Physical Availability)	10	10	100	8	80	7	70	10	100
Cost	4	10	40	3	12	5	20	0	0
Timeliness	6	10	60	2	12	7	42	1	6
Water Quality	2	10	20	10	20	10	20	10	20
Final Weighted Score			380 *		274 +		222		266

* Recomended source of water supply
\+ First alternative source of water supply

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

WATER-SUPPLY SOURCE MATRIX
DRY LAKE VALLEY, NEVADA

28 SEPT 81

TABLE 4.11

current and proposed ground-water use is considered as well as the quantity of water in storage in the aquifer.

The development of the carbonate aquifer in Dry Lake Valley is considered a much more feasible alternative source of water supply than importation of water, even though it ranked only slightly higher than importation in the matrix evaluation. The results of a carbonate aquifer test conducted by Ertec near the northwest margin of the valley indicate that the carbonate aquifer has a high potential for development; however, development of the carbonate aquifer would be about three times more costly than the valley-fill aquifer and would require four times more time to construct the supply wells. The relatively high yield potential indicated by the existing carbonate test well suggests that some combination of pumping from the valley-fill and the carbonate aquifers may be viable.

Importation of water is ranked third among the four options, although it compares favorably with development of the carbonate aquifer. Importation ranked high because of the legal and physical water availability in the source valley, which would be Spring Valley. The matrix evaluation is weighted more toward legal and environmental considerations of water use and less toward MX water-supply system construction. However, importation of water from the nearest valley where it is plentiful is estimated to cost as much as 40 times development of the valley-fill aquifer and 14 times development of the carbonate aquifer.

Lease or purchase of existing water rights is presently not recommended because there are only 19 acre-ft/yr (0.02 hm^3/yr) of approved ground-water rights (Woodburn and others, 1981) and 21 acre-ft/yr (0.03 hm^3/yr) of surface-water rights (DRI, 1980). These total less than one percent of the MX peak-water requirement for Dry Lake and Muleshoe valleys combined in 1984.

4.5.3 Suitable Areas for Water-Supply Well Locations

Two large areas in Dry Lake Valley have been identified as primary areas for development of the valley-fill aquifer (Drawing 4-5). In the northern part of the valley, there is an extensive primary area in the central valley and flanking alluvial fans. In the central and southern part of the valley, a 0.25- to 3-mile (0.4- to 5-km) wide strip of primary areas occurs between the lacustrine sediments in the valley floor and the edge of the valley. In Township 3S, these strips coalesce into one and extend southward into Delamar Valley.

The primary area for development of the valley-fill aquifer in Dry Lake Valley is extensive and is capable of providing well locations for the construction and operation of the MX missile system.

Due to the extensive deposition of lacustrine deposits in central and southern Dry Lake Valley, a large area is classified as secondary. This area extends from the north-central part of Township 1N to the central part of Township 3S and is 5 to 6 miles (8 to 10 km) wide.

Additional small secondary areas have been delineated on the western flank of the valley in Township 1S and on the southwest flank of the mountains in Township 3S. These areas are classified as secondary on the basis of geophysical and water-level data which indicate that only thin saturated thicknesses of valley-fill sediments occur. There is only one Air Force water-appropriation application point of diversion in the valley, and it lies in a secondary water-supply well development area at 3S-64E-12ac (number 40433).

There is only one cultural exclusion within the valley-floor area in Dry Lake Valley which is located in Township 1S near the east side of the valley. There are, however, four water-appropriation exclusions in the northern part of the valley floor and two water-appropriation exclusions in the central portion of the valley floor. These exclusions include the area within 1 mile (1.6 km) of an existing ground-water or surface-water appropriation. Other water-appropriation exclusions are found in the mountains adjacent to the valley. A possible regional spring occurs in Dry Lake Valley at 3N-65E-31cc.

4.5.4 Water-Supply System Alternatives

Based upon the available hydrologic data and the matrix analyses conducted as part of this investigation, there are three feasible MX water-supply alternatives for Dry Lake Valley. The alternative which can be ultimately used is largely dependent upon the decision of the State Engineer regarding temporary overdraft of the Dry Lake Valley ground-water basin. The three

alternatives, listed in order of priority from a technical standpoint, are discussed below.

4.5.4.1 Alternative I

The first alternative involves splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing test well at 3S-64E-12ca and the carbonate test well at 3N-63E-27cc, and the construction of two additional water-supply wells in the valley-fill aquifer. This approach will require the amendment of the pending application. This process should be initiated early in FY 82 to ensure that there is available water for the initial MX construction activities scheduled to begin in mid-1982.

The proposed LSC, presumed to be located in 3S-64E, will require from 230 to 1050 acre-ft/yr (0.28 to 1.29 hm^3/yr) with the peak requirement in 1986. Based upon an estimated well yield of 750 gpm (47 l/s), only one water-supply well will be required to deliver the 651 gpm (41 l/s) needed for peak water use at the LSC. The existing Air Force test well at 3S-64E-12ca has been pumped at a maximum rate of 750 gpm (47 l/s) and, if a sustained yield of 651 gpm (41 l/s) is possible, no additional MX water-supply wells will be required. During the period from 1983 to 1985, and during 1987, surplus water from the existing well could be utilized for DTN and cluster construction in the southern end of the valley.

The development of MX water-supply wells for DTN and cluster construction, operation, and reclamation will require the use of the existing Air Force valley-fill well at 3S-64E-12ca, the use of the existing carbonate exploration well at 3N-63E-27cc, and the construction of two additional MX water-supply wells.

In 1982 and 1983, the entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force valley-fill well. In 1984, however, the existing Air Force carbonate exploration well located at 3N-63E-27cc and three additional wells will be required to deliver the 3373 acre-feet (4.16 hm^3) which will be required. It is recommended that one additional valley-fill well be constructed in the primary area in the southern part of the valley and one valley-fill well be constructed in the primary area in the northern part of the valley. Assuming well yields of 650 gpm (41 l/s) or 1047 acre-ft/yr (1.29 hm^3/yr) if pumped continuously, these wells should be capable of supplying more than the MX water requirement (3373 acre-feet [4.16 hm^3]) during the peak-construction year. For the period from 1985 to 1986, the MX water requirements for nondomestic purposes decrease and a reduction in the pumping rates of the water-supply wells can occur.

4.5.4.2 Alternative II

If the State Engineer restricts MX ground-water withdrawal from the valley-fill aquifers of Dry Lake hydrographic basin (Dry Lake and Muleshoe valleys) to the perennial yield of 3000

acre-ft/yr (3.70 hm^3/yr) but allows additional water to be withdrawn from the carbonate aquifer, as much as 1341 acre-feet (1.65 hm^3) may have to be withdrawn from the carbonate aquifer in 1984. This alternative would then involve splitting the pending Air Force water-appropriation point of diversion at the existing Air Force test well at 3S-64E-12ca (number 40433) into multiple points of diversion, use of the existing valley-fill aquifer test well at 3S-64E-12ca, increasing the diameter of the carbonate aquifer test well at 3N-63E-27cc, and the construction of an additional valley-fill and carbonate aquifer well.

Although the carbonate test well at 3N-63E-27cc had a sustained yield of 106 gpm (7 l/s), the drawdown in the well was only 2 feet (0.6 m). Discharge from the well was limited by the greater than 800 feet (244 m) water depth and by small well diameter. A larger capacity pump, necessitating a larger diameter well, can be expected to increase the well yield to at least 450 gpm (28 l/s) or 725 acre-ft/yr (0.89 hm^3/yr) pumped continuously.

The entire MX water requirement in Dry Lake Valley can be met through the operation of the existing Air Force test well at 3S-64E-12ca in 1982, 1983, and 1987. In 1984, however, two carbonate wells, including the existing carbonate well at 3N-63E-27cc with an increased diameter, and one additional well in the valley-fill aquifer would be used to supply the required water. In 1985, most of the required water can be supplied by two wells tapping the valley-fill aquifer and only minimal water will be needed from a well in the carbonate aquifer. No water will be required from the carbonate aquifer in 1986.

4.5.4.3 General Well Characteristics

An Air Force well constructed in the valley-fill aquifer at 3S-64E-12ca (number 40433) was pumped at a constant discharge rate of 500 gpm (32 l/s), and results suggest that a higher sustained yield is possible. The valley-fill well was constructed with a 16-inch (41-cm) borehole and a 10-inch (25-cm) ID casing to a total depth of 1012 feet (308 m). Larger diameter wells may be capable of greater sustained yields if the same favorable aquifer is penetrated. Although the depth to water ranges from about 800 feet (244 m) below land surface in the northern part of the valley to over 300 feet (91 m) in the southernmost part of the valley, the depth to productive aquifer may be substantially greater. Therefore, it is recommended that MX water-supply wells be constructed to depths of at least 1200 feet (366 m). Due to the lack of hydrologic data for aquifer characteristics and well yields for much of Dry Lake Valley, it is recommended that exploratory drilling be conducted to verify the proposed locations of other MX water-supply wells.

4.5.5 Additional Investigations

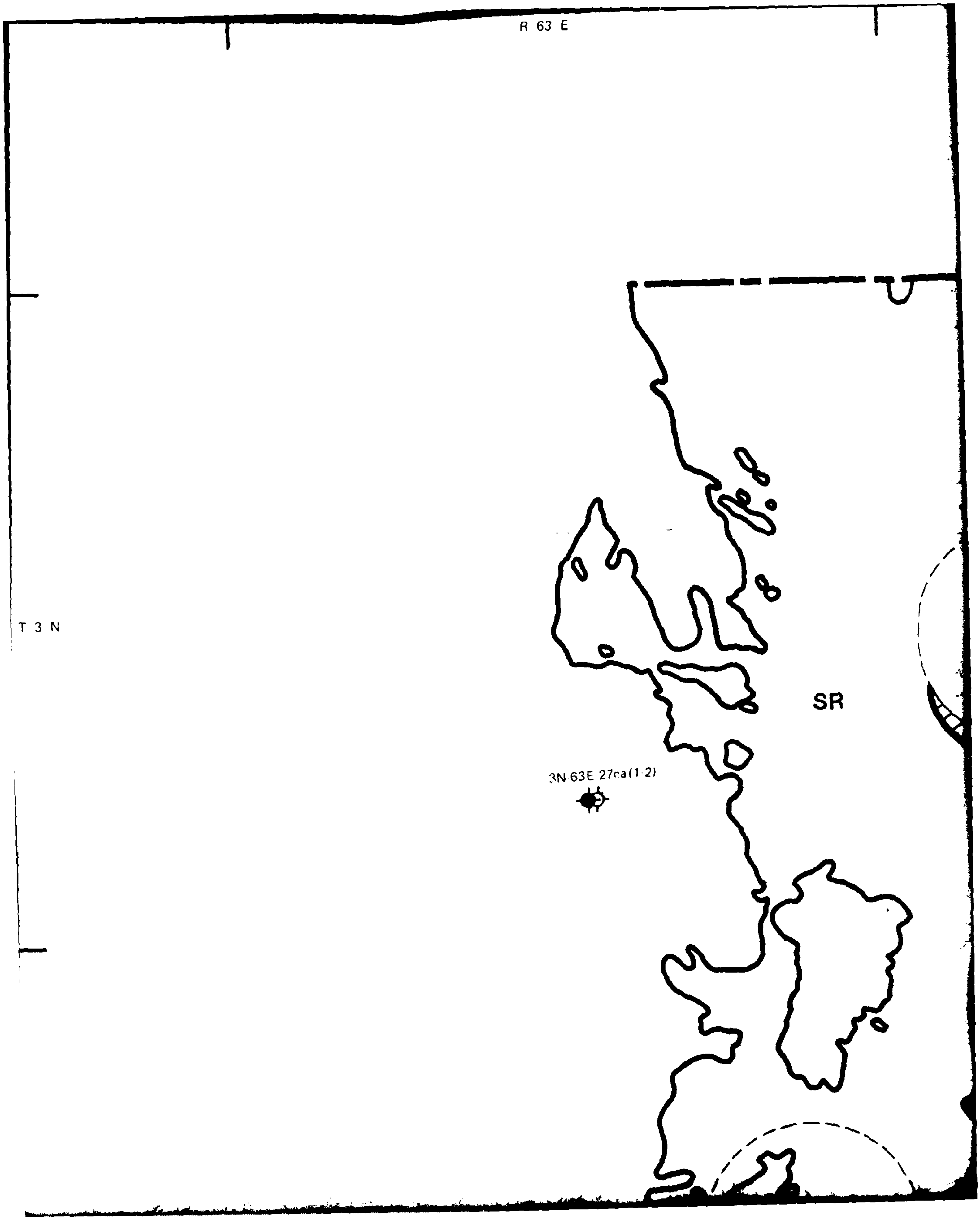
Suggested possible sites for additional drilling and testing prior to operational development of the water-supply system are identified in Drawing 4-5.

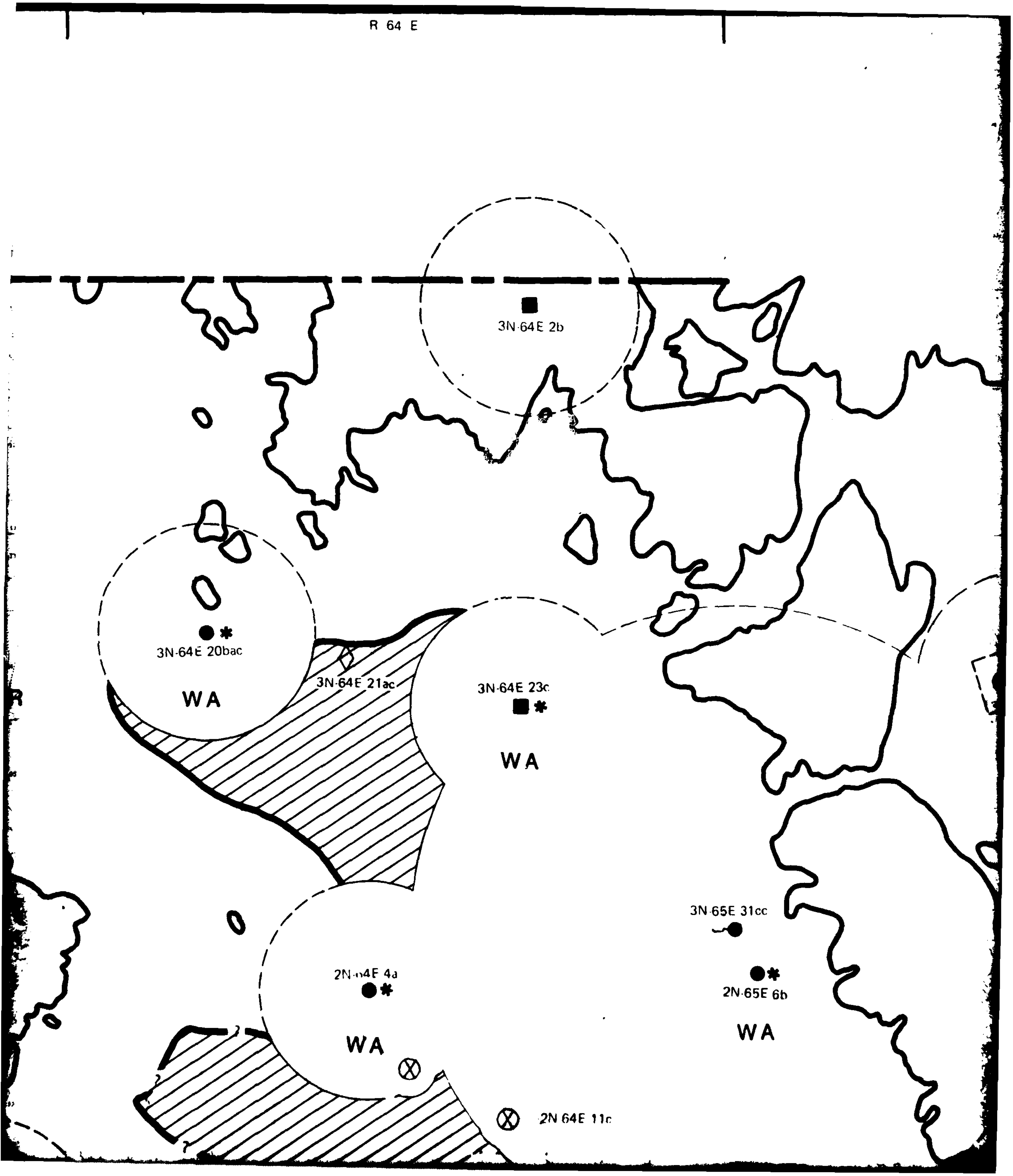
An application was filed for only one point of diversion in Dry Lake Valley at 3S-64E-12ca (number 40433). The request for water at this point of diversion was sufficient to meet the peak MX water requirement for construction in the valley.

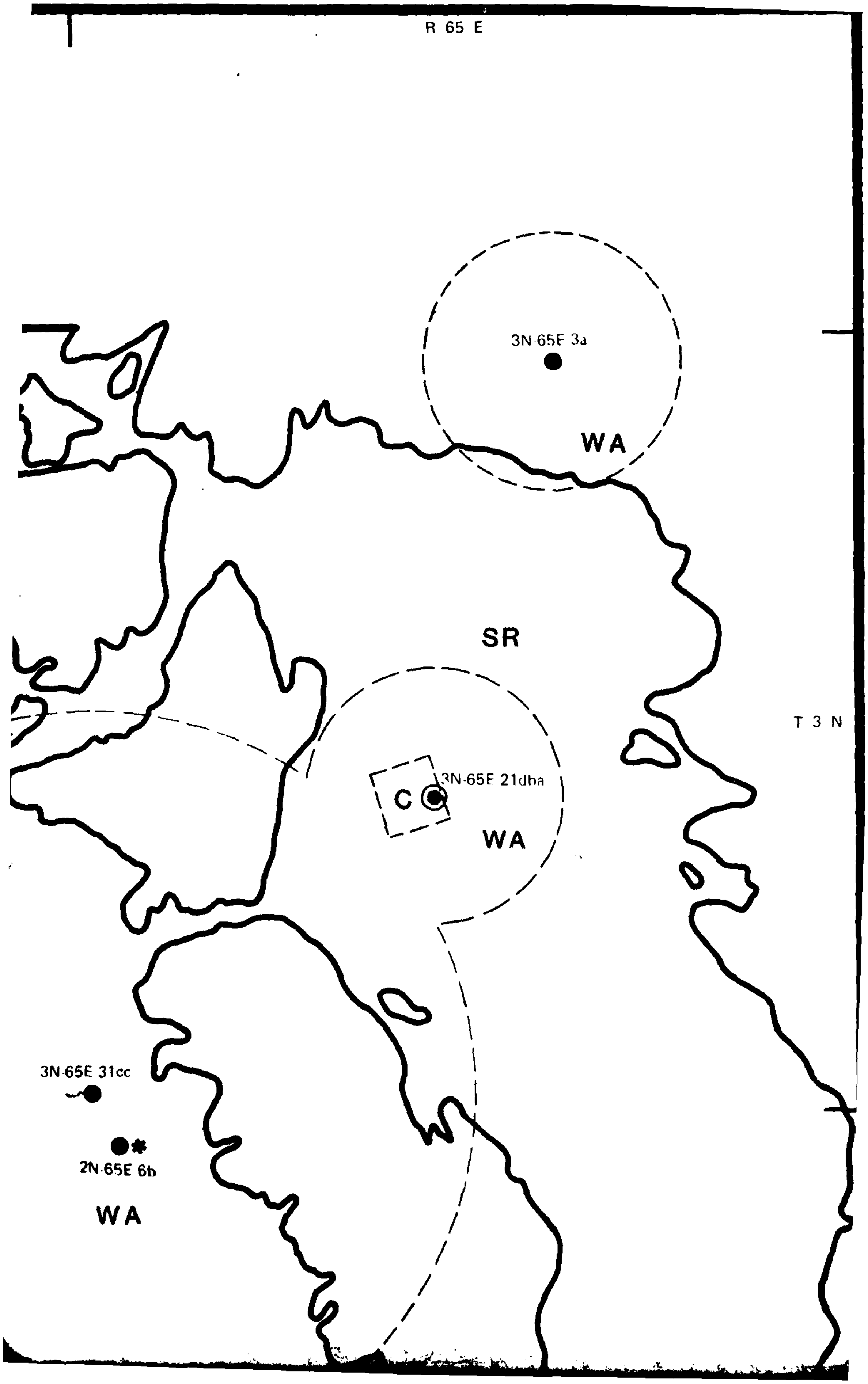
Two additional drilling sites have been identified beyond the application point of diversion in Dry Lake Valley. These sites were selected along existing roads in primary water-supply areas delineated in Drawing 4-5.

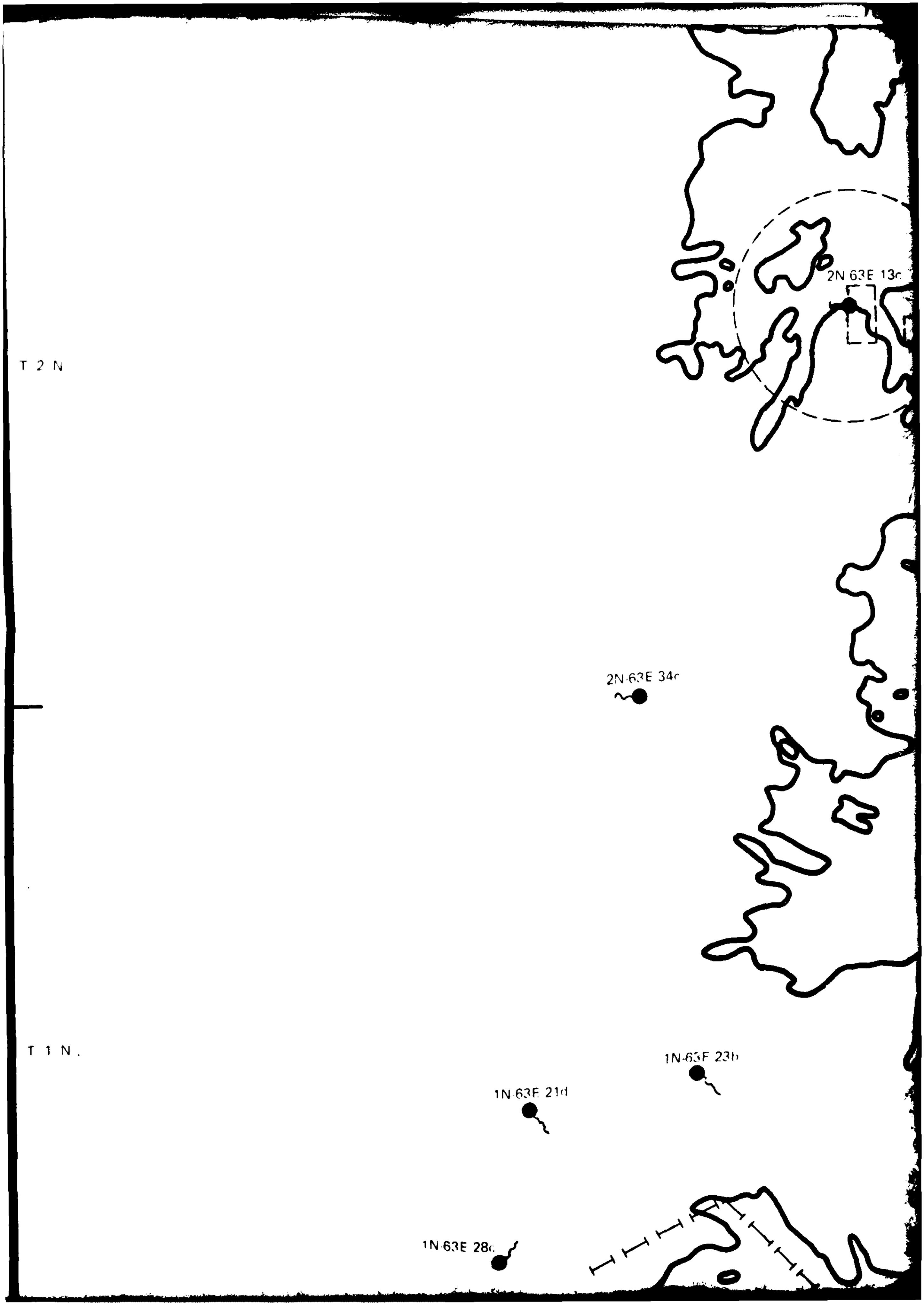
The drilling site located at 3N-64E-2ac in the northern part of the valley is the first priority. The site is located 3 miles (5 km) south of the proposed construction camp at the northern end of Dry Lake Valley. A well at this location could provide data on water quantity and quality, both of which will be necessary for planning domestic water supply at the construction camp. This site is also strategically located with respect to clusters and is approximately 1 mile (1.6 km) from the DTN in an area where little or no aquifer performance data exist.

The drilling site at 2N-64E-36cc is centrally located with respect to the DTN and the clusters. The site at 2N-64E-36cc in north-central Dry Lake Valley is approximately 12 miles (19 km) south of a proposed construction camp. Aquifer data within a 5-mile (8-km) radius are limited to one stock well.


R 63 E
T 3 N
SR
3N 63E 27ca(1-2)

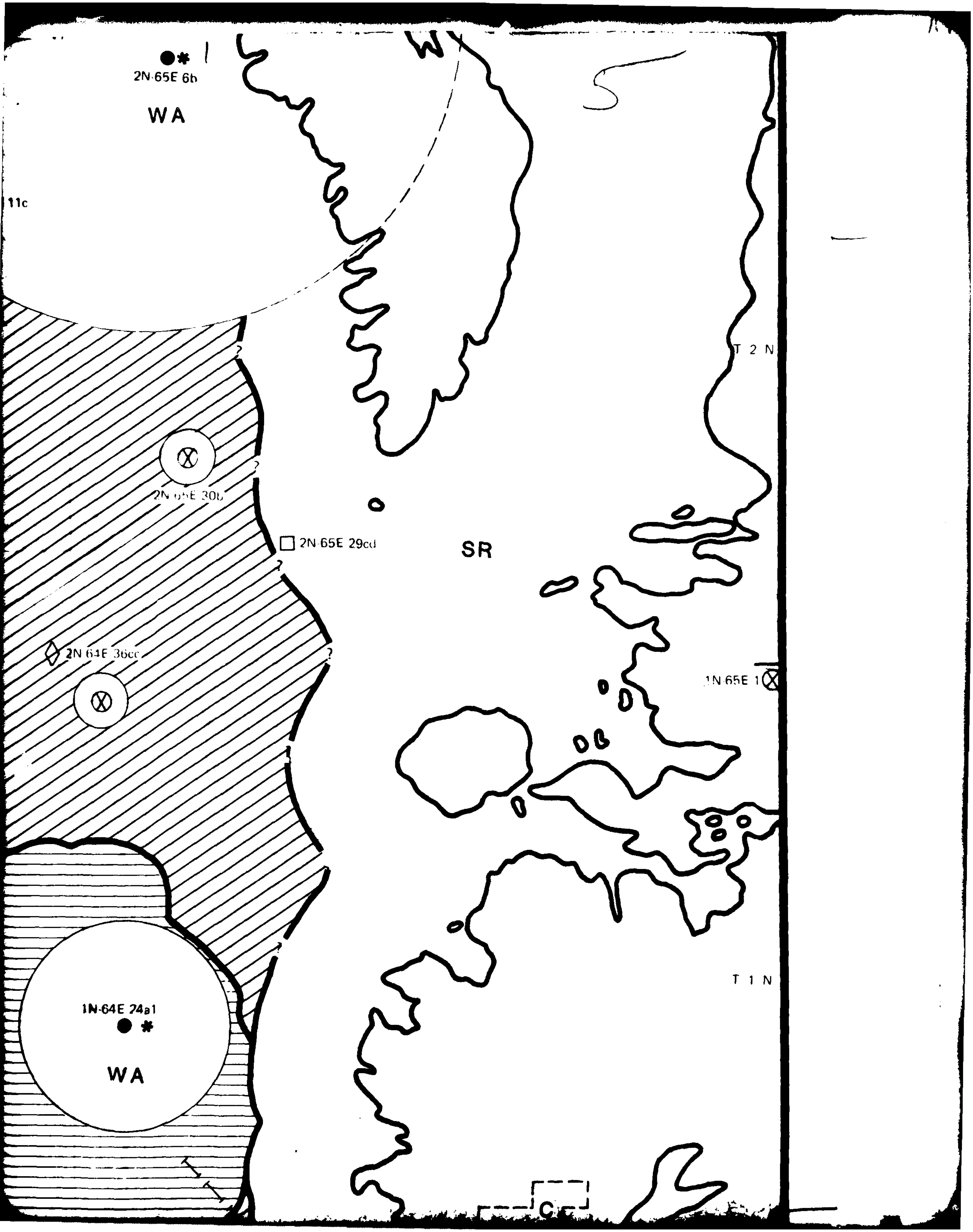

R 64 E
3N-64E 2b
3N-64E 20bac
WA
3N-64E 21ac
3N-64E 23c
WA
3N-65E 31cc
2N-64E 4a
2N-65E 6b
WA
WA
2N 64E 11c


R 65 E
3N-65E 3a
WA
SR
T 3 N
C
3N-65E 21dba
WA
3N-65E 31cc
2N-65E 6b
WA

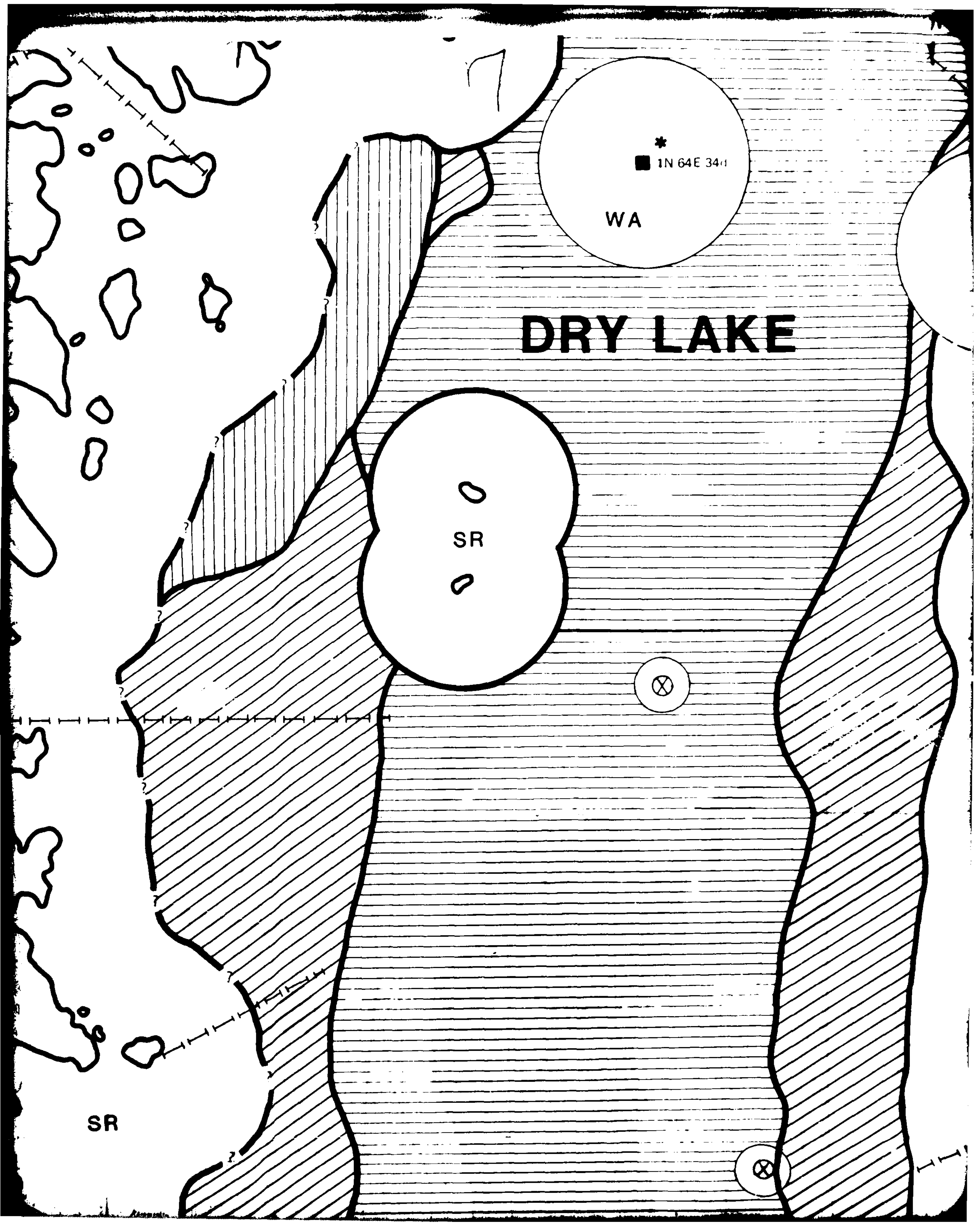


T 2 N
2N 63E 13c
2N-63E 34c
T 1 N.
1N-63E 23b
1N-63E 21d
1N-63E 28c

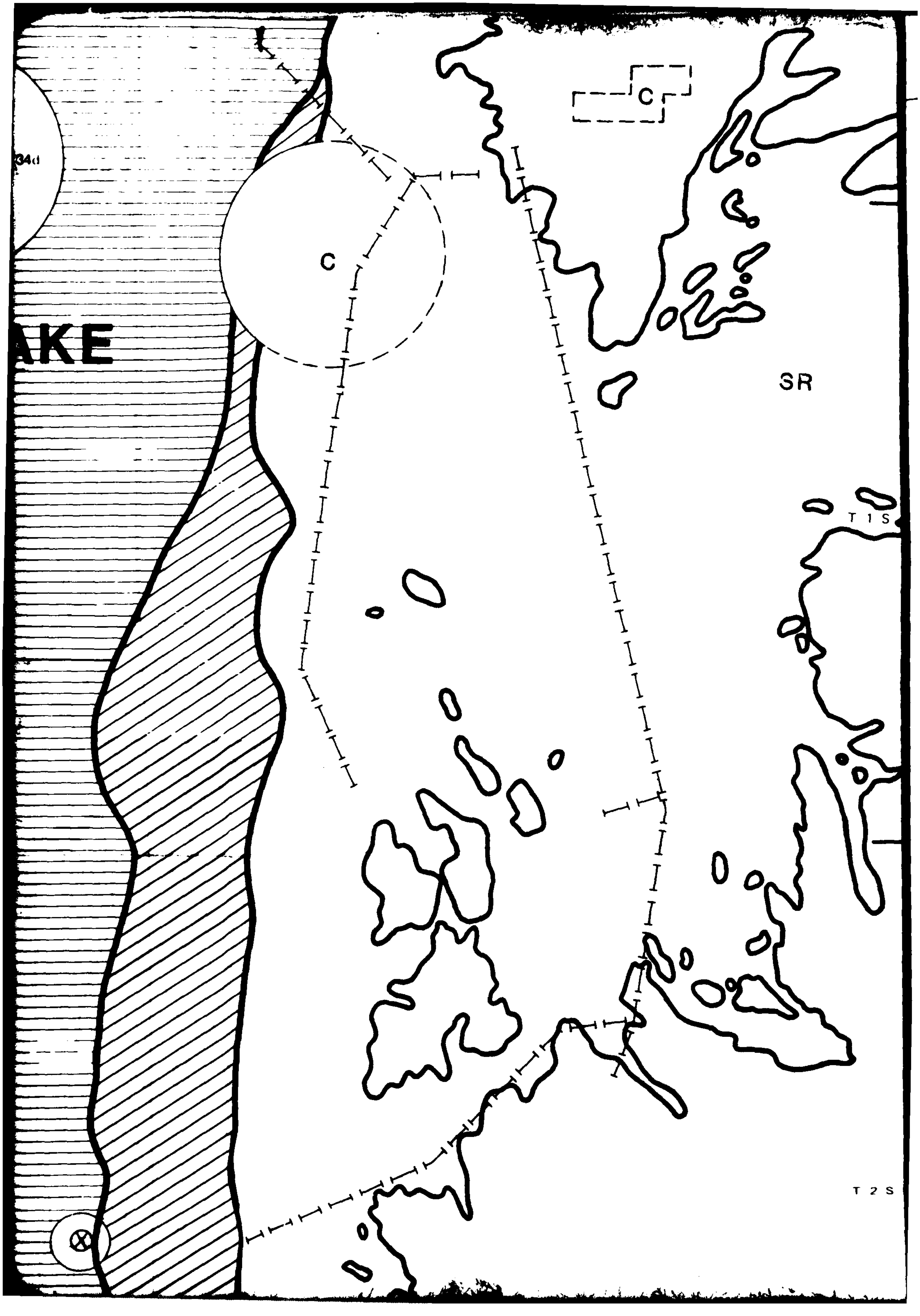
2N-64E 4a
2N-65E 6b
WA
WA
2N 64E 11c
2N-63E 13c
2N 64E 36cc
1N-64E 24a1
WA
E 23b
SR

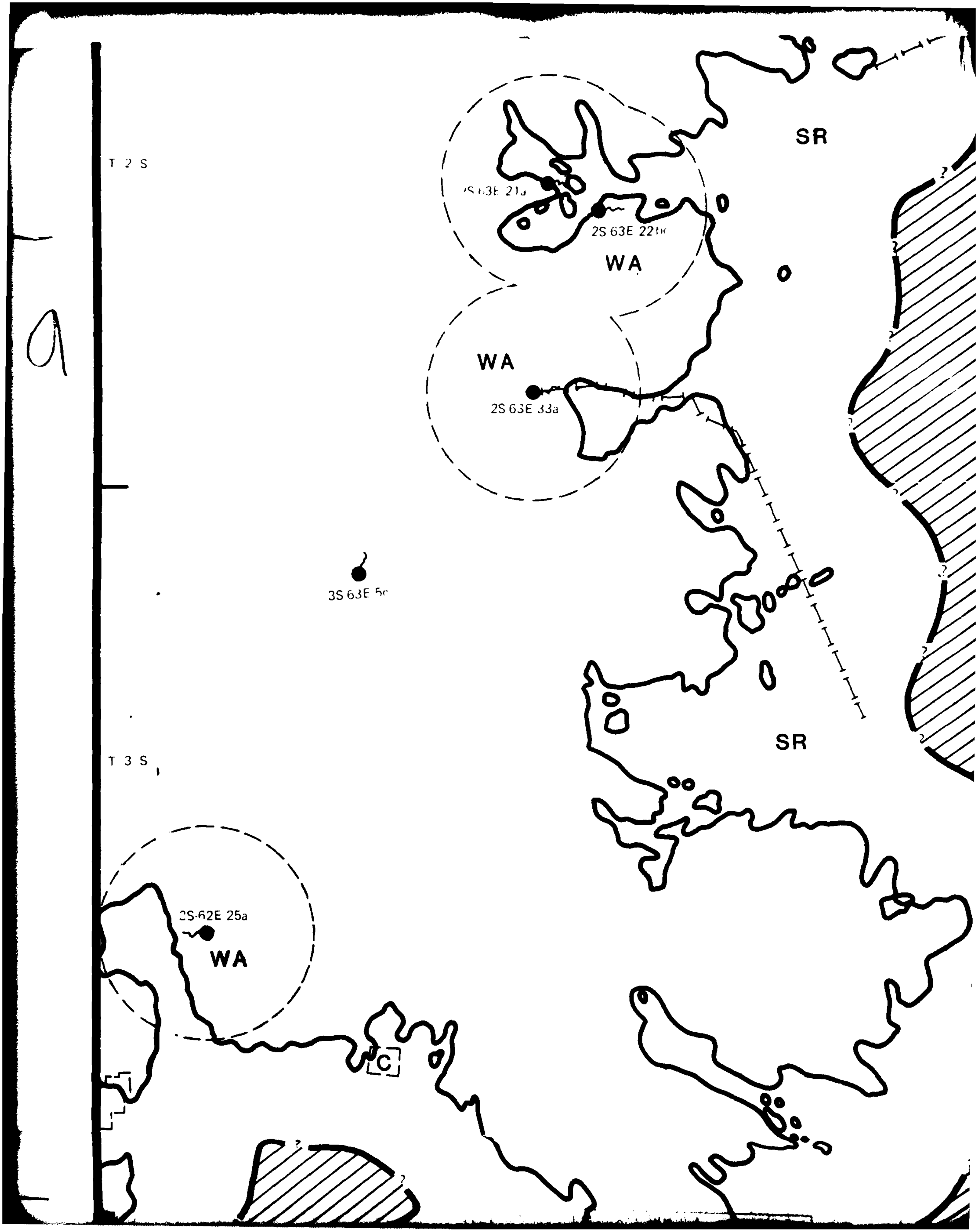

2N-65E 6b
WA
11c
T 2 N
2N-65E 30b
2N-65E 29cd
SR
2N-64E 36cc
1N-65E 1
T 1 N
1N-64E 24a1
WA
C

T 1 S
WA
1S-63E 33b
SR
T 2 S
2S-63E 21a

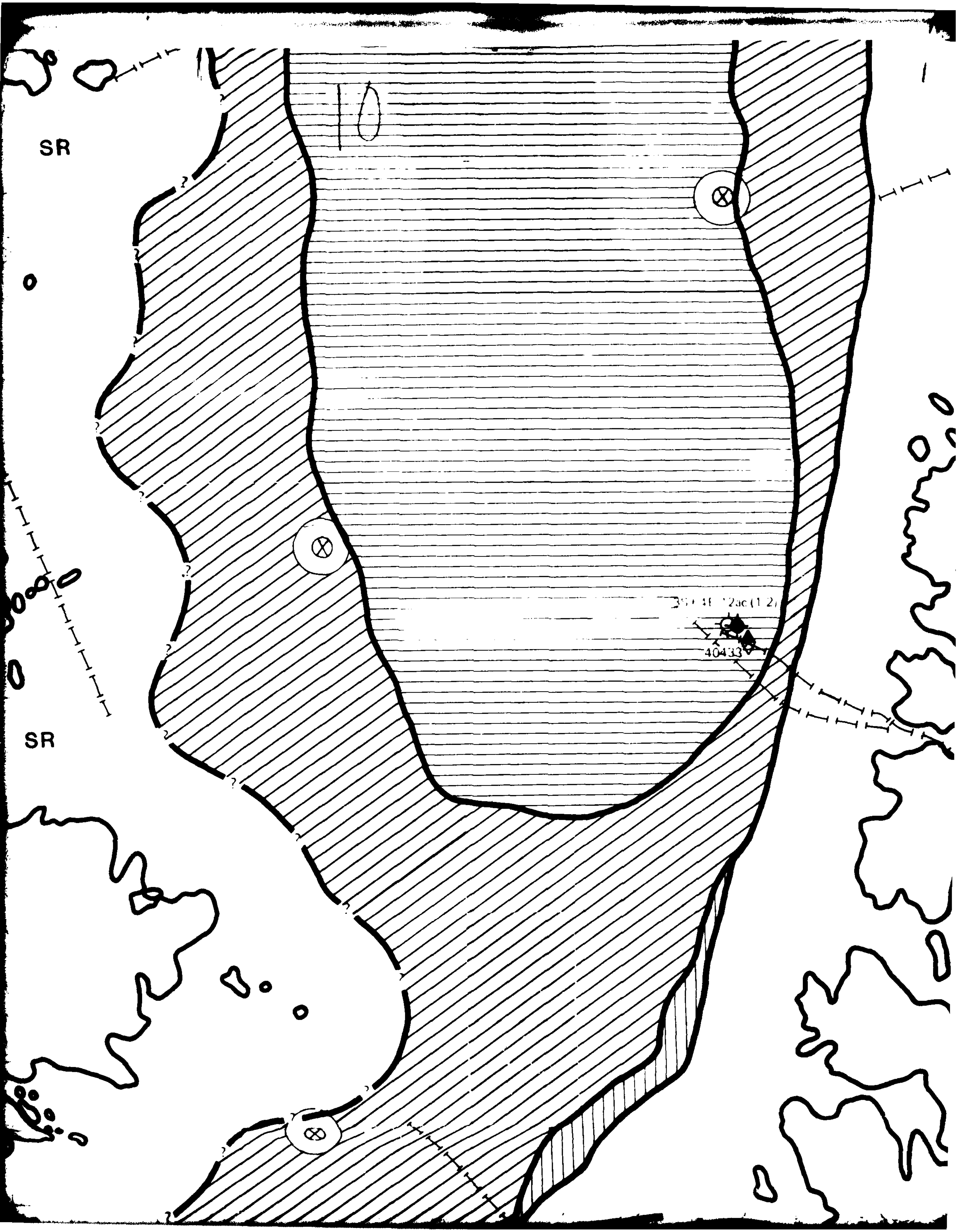


DRY LAKE
WA
1N 64E 34d
SR
SR

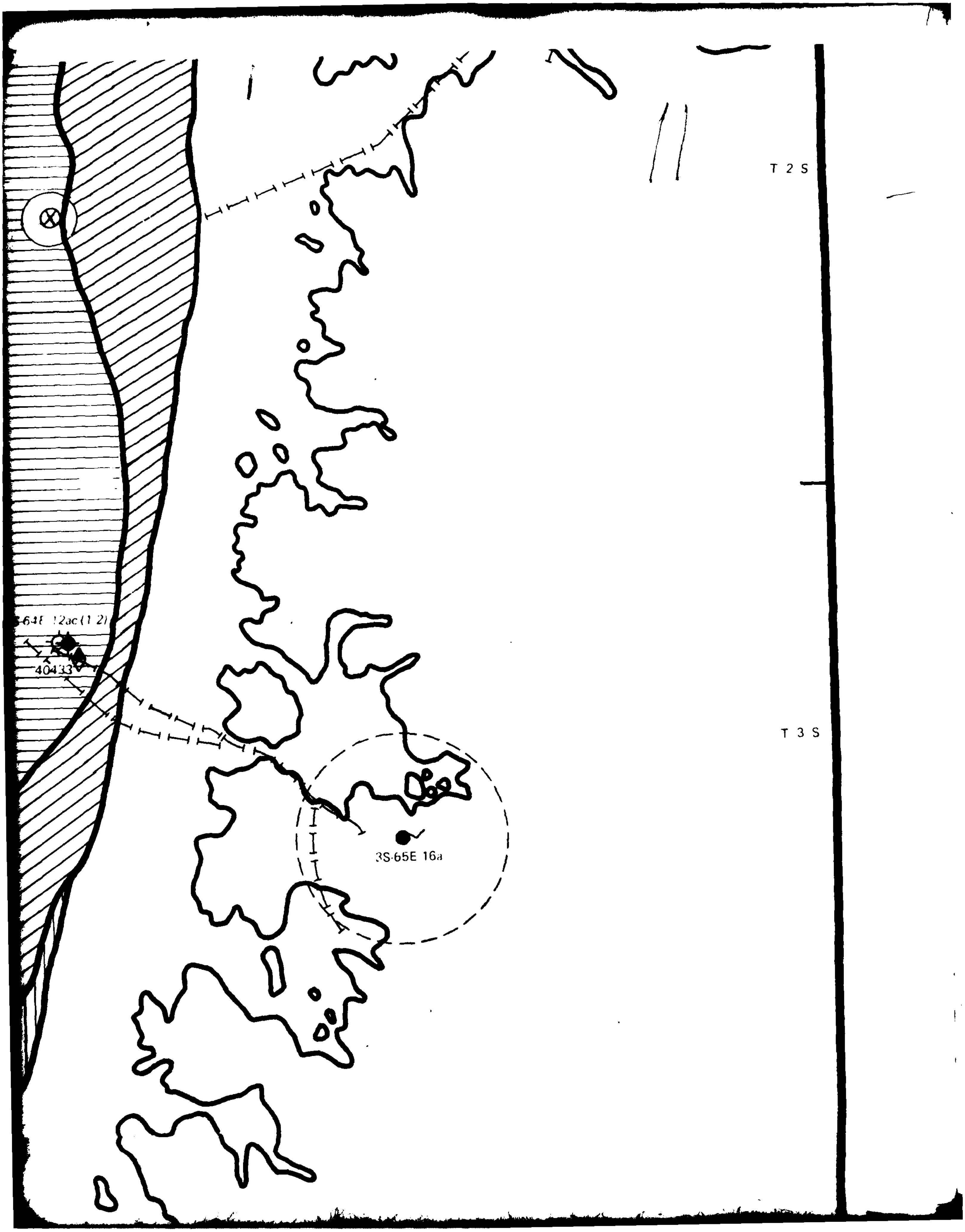

34d
C
C
AKE
SR
T 1 S
T 2 S

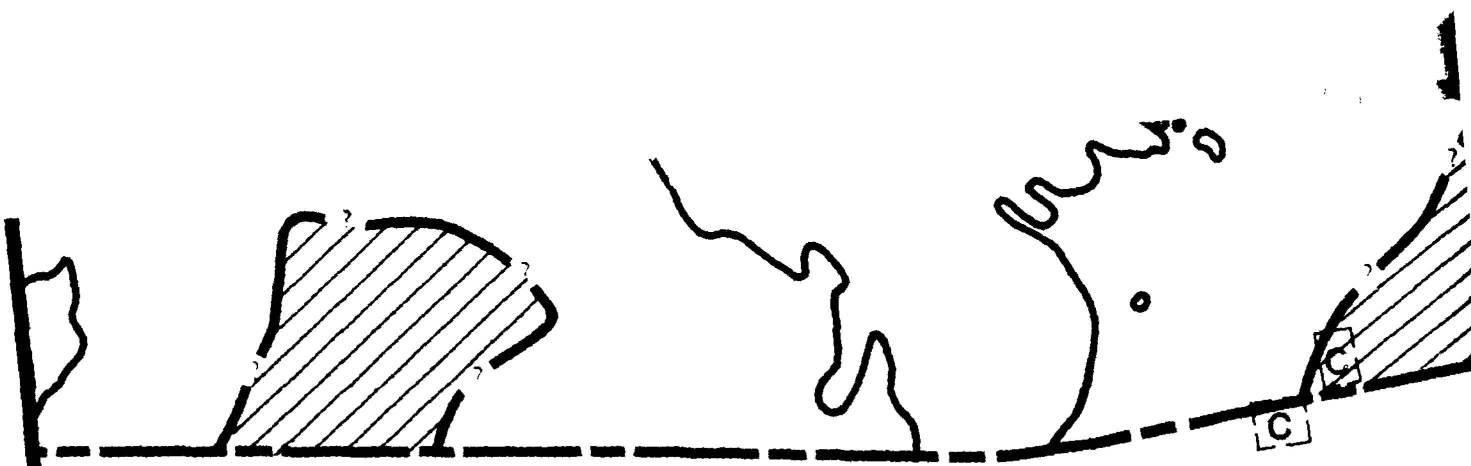


a
T 2 S
SR
2S 63E 21a
2S 63E 22bc
WA
WA
2S 63E 33a
3S 63E 5c
SR
T 3 S
2S-62E 25a
WA
C



SR
SR
40433


T 2 S
3-64E 12ac(1 2)
40433
3S-65E 16a
T 3 S



EXPLANATION

SYMBOLS

POWERLINE(S)

TELEPHONE/TELEGRAPH

PIPELINE

DRAINAGE DIVIDE

VALLEY BOUNDARY

ROCK - VALLEY-FILL CONTACT

? ? PREFERRED AREA BOUNDARY; QUERIED WHERE GEOPHYSICAL AND/OR WATER LEVEL DATA IS SUBJECT TO GREATER MARGIN OF ERROR

CULTURAL OR WATER APPROPRIATION EXCLUSION BOUNDARY, DASHED IN AREAS OF OTHER EXCLUSIONS

41222 AIR FORCE WATER APPROPRIATION (APPLICATION NUMBER SHOWN)

41221 AIR FORCE WATER APPROPRIATION: ADDITIONAL DRILLING/TESTING RECOMMENDED (APPLICATION NUMBER SHOWN)

ADDITIONAL DRILLING/TESTING RECOMMENDED LOCATION

AIR FORCE OBS. WELL

AIR FORCE TEST WELL

DOMESTIC/STOCK WELL

MUNICIPAL/IRRIGATION WELL

UNDESIGNATED WELL

ABANDONED WELL

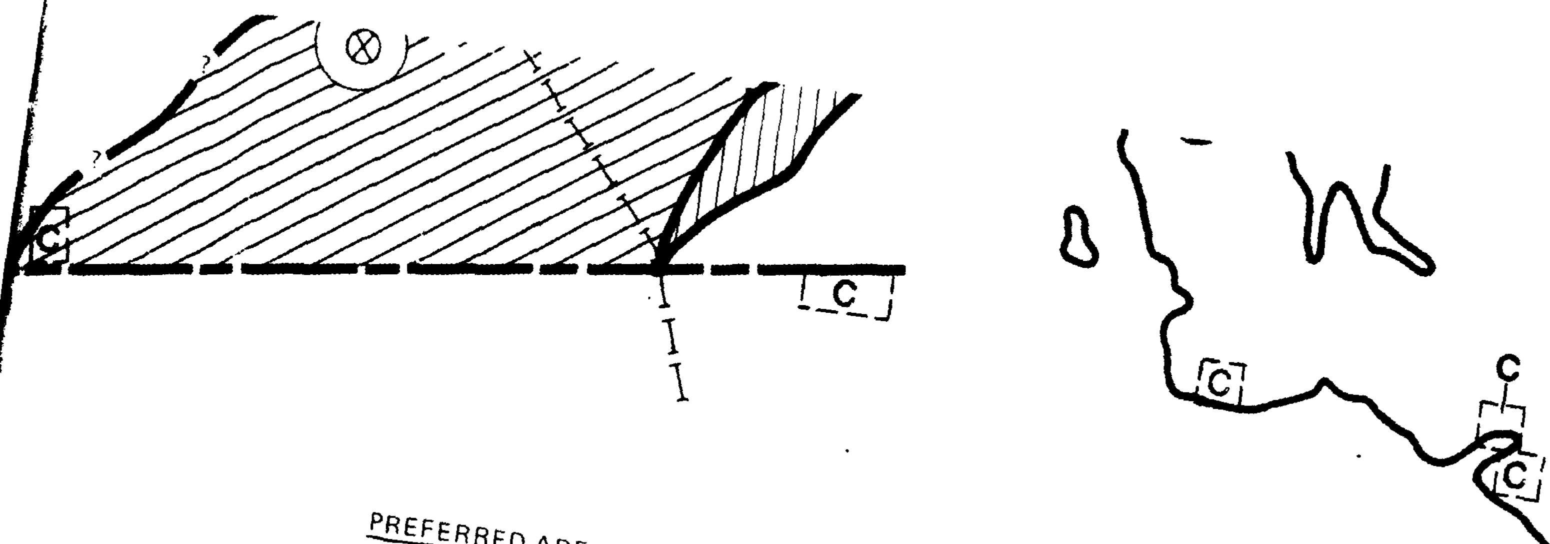
SPRING

STREAM APPROPRIATION

UNDESIGNATED APPROPRIATION

RESERVOIR

* POSSIBLE EXISTING WELL, UNVERIF WATER APPROPRIATION



LL

LL

EL'

ION WELL

LL

TION

ROPRIATION

WELL, UNVERIFIED
ION

PREFERRED AREAS

PRIMARY

SECONDARY: LACUSTRINE

SECONDARY: LIMITED SATURATED THICKNESS

AREAS OF EXCLUSION

WA : WATER APPROPRIATION

C : CULTURAL

SR : SHALLOW ROCK

REFERENCE

Desert Research Institute, 1980, Water rights in Nevada and Utah: an inventory within the MX area, Water Resources Center, University of Nevada System, unpublished report.

Ertec Western, Inc., 1981, MX water resources, potentiometric map - Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale.

Fugro National, Inc., 1980, MX siting investigation, gravity survey – Dry Lake Valley, Nevada, FN-TR-33-DL, unpublished report, 30 January 1980

__________ 1980, MX siting investigation, non-geotechnical map – Dry Lake Valley, Nevada, unpublished map, 1: 62,500 scale, July 1980

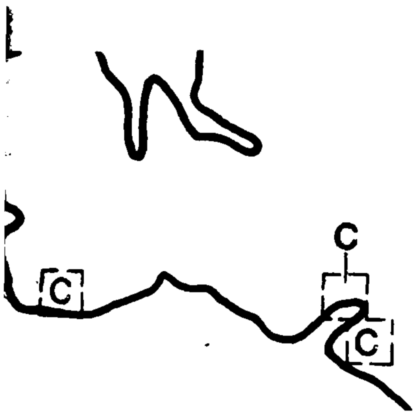
__________ 1980, verfication study, Dry Lake Valley, Nevada, FN TR 27 DL V. I, V. II

Ert
The Earth Technolog

DI
PR

28 SEPT 81

13



E

Watcr rights in Nevada
h the MX area, Water
of Nevada System, un-

er resources,
ke Valley, Nevada,
ale.

ting investigation,
ley, Nevada,
port, 30 January 1980.

ting investigation,
Lake Valley, Nevada,
cale, July 1980.

tion study, Dry
7-DL V. I, V. II.

NORTH

SCALE 1:62,500

0 1 2
STATUTE MILES

0 1 2
KILOMETERS

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

DRY LAKE VALLEY, NEVADA
PREFERRED AREAS FOR MX
WATER-SUPPLY WELLS

28 SEPT 81 DRAWING 4-5

14

B1.0

NUMERICAL MODELING STUDIES,
DRY LAKE VALLEY

C1.0

RESULTS OF AQUIFER TESTING,
DRY LAKE VALLEY

D1.0

DRY LAKE VALLEY SECTION: MX SITING INVESTIGATION, TECHNICAL SUMMARY REPORT

2.8 DRY LAKE VALLEY

2.8.1 GENERAL PHYSIOGRAPHY AND HYDROLOGY

Dry Lake Valley is a north-trending basin in Lincoln County, Nevada. The valley is topographically open to Muleshoe Valley to the north and is separated from Delamar Valley to the south by a low alluvial divide. Dry Lake and Muleshoe valleys are considered one hydrologic basin by the Nevada State Engineer. Dry Lake Valley is 38 miles (61 km) long, 21 miles (34 km) across at its widest point, and encompasses 700 mi^2 (1812 km2), of which 310 mi^2 (803 km^2) are suitable for MX deployment. The average valley floor elevation is 4800 feet (1463 m). The valley is bordered by the North Pahroc Range on the west and the Burnt Springs, Highland and Bristol ranges on the east. The mountain crests range in elevation from about 7000 feet (2134 m) to over 9000 feet(2743 m).

Perennial streamflow is absent in Dry Lake Valley there is some ephemeral surface-water inflow from Muleshoe Valley, however, total runoff from the mountains at the apex of the alluvial fans is estimated to be 9000 acre-ft/yr (11.1 hm^3/yr) (Nevada State Engineer, 1971). This estimate is for the combined Dry Lake, Muleshoe, and Delamar valleys hydrographic areas. Small springs in or near the base of the mountains surrounding Dry Lake Valley issue from the clastic rocks of Paleozic age and the volcanic and clastic rocks of Tertiary age. Four springs discharged from 0.5 to 2 gpm (0.03 to 0.1 l/s), when measured in May 1980 by Ertec personnel.

Ground-water recharge is from the infiltration of precipitation in stream channels and surface runoff on the alluvial fans. The average annual recharge for Dry Lake/Muleshoe valleys is estimated to be 4800 acre-ft/yr (5.9 hm^3/yr) (Eakin, 1963). Of this amount, approximately 2100 acre-ft/yr (2.6 hm^3/yr) is derived from precipitation in the mountains around Muleshoe Valley with the remainder from sources within Dry Lake. Evapotranspiration and water discharged by wells is less than 100 acre-ft/yr (0.1 hm^3/yr). Evapotranspiration only occurs in limited areas near small springs.

The Dry Lake Valley basin is a hydrologically open system with underlfow to the south or southwest and possibly to the west through the carbonates of Paleozoic age. Total discharge by underflow is estimated to be 5000 acre-ft/yr (6.2 hm^3/yr) (Nevada State Engineer, 1971) This is considered in agreement with Eakin's (1963) estimate of 4800 acre-ft/yr (5.9 hm^3/yr) recharge because the State Engineer°s figure is rounded to the nearest thousand acre-foot. The hydraulic gradient in the valley fill aquifer is southward at 16 ft/mi (3 m/km) from central Dry Lake Valley to central Delamar Valley (Figure B1.8). The potentiometric surface ranges in elevation from 5000 feet in the north to 4200 feet in the south (1524 to 1280 m) based on the regional potentiometric map. The depth to ground water in Dry Lake Valley is in excess of 300 feet (91 m), thus, there is no evapotranspiration of ground water by phreatophytes. The valley-fill aquifer in Dry Lake Valley is probably over

10,000 feet (3048 m) thick in the central part of the valley and is composed of alluvial fan, fluvial, playa, and lacustrine deposits (FN-TR-33DL, FN-TR-26E). Eakin (1963 describes the valley-fill sediments as clay, silt, sand, and gravel of Tertiary to Quaternary age deposited under subaerial and lacustrine conditions.

Carbonate rocks of Paleozoic age are exposed in the mountains and are believed to partially underlie the valley-fill sediments. The mountains bordering Dry Lake Valley to the west contain ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. The mountains to the east contain carbonates of Paleozic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

2.8.2 MX WATER REQUIREMENTS

The peak annual demand for ground water in Dry Lake Valley during the construction phase is expected to be 3411 acre-ft (4.2 hm^3) in 1984 according to preliminary figures from the U.S.Army Corps of Engineers (1981) as revised by Ertec (1981). Construction should begin in 1982 and conclude in 1987. Water demand for the operational phase of the MX project is expected to be less than 300 acre-ft/yr (0.4 hm^3/yr) for the 30 year life of the project.

The Air Force has requested 3810 acre-ft/yr (4.7 hm^3/yr) for appropriation in Dry Lake Valley. It should be noted that the amount of water needed in Dry Lake Valley for construction and operation is expected to be less than this because the applicat-

ions were filed before the latest cluster layouts and water requirements were determined.

2.8.3 WATER SUPPLY LIMITATIONS

2.8.3.1 Perennial Yield, Use, and Appropriations

The combined perennial yield for Dry Lake/Muleshoe valleys is estimated to be 3000 acre-ft/yr (3.7 hm^3/yr) (Nevada State Engineer, 1971). This was apparently based on Eakin's (1963) estimate of 6000 acre-ft/yr (7.4 hm^3/yr) discharge for the combined Muleshoe, Dry Lake, and Delamar valleys. The discharge was divided, and a combined perennial yield of 3000 acre-ft/yr (3.7 hm^3/yr) was assigned to Dry Lake/Muleshoe valleys.

Surface-water use, primarily for stock watering, is estimated to be 21 acre-ft/yr (0.03 hm^3/yr)in Dry Lake Valley. Surface-water appropriations in the appropriation and permit phase total 2596 acre-ft/yr (3.2 hm^3/yr) (DRI, 1980). At the present time, ground-water use is minor in Dry Lake Valley. Current ground-water permits total 8 acre-ft/yr (0.01hm^3/yr), certificates total 11 acre-ft/yr (0.01 hm^3/yr), and there are a total of 20 acre-ft/yr (0.03 hm^3/yr) of pending applications for ground-water rights in the valley (Woodburn, et al, 1981).

The quantity of ground water available for MX use is approximately 3000 acre-ft/yr (3.7 hm^3/yr)when considering existing use. The water availability is 2981 acre-ft/yr (3.7 hm^3/yr) when considering approved appropriations and 2961 acre-ft/yr (3.7

hm^3/yr) when considering both existing and pending applications. The peak MX demand of 3411 acre-ft/yr (4.2 hm^3/yr) for ground water will exceed the reported perennial yield by 411 acre-ft/yr (0.5 hm^3/yr). When considering existing appropriations, the perennial yield will be exceeded by 430 acre-ft/yr (0.5 hm^3/yr). Because the State Engineer considers Muleshoe Valley as part of Dry Lake Valley for perennial yield estimates, its ground-water demand must also be considered. Peak year MX demand for Muleshoe Valley is 968 acre-ft (1.2 hm^3) in 1984. Therefore, the combined peak construction water demand in 1984 and the existing appropriations will exceed the perennial yield by 1398 acre-ft/yr (1.7 hm^3/yr). However, if Dry Lake/Muleshoe valleys are hydrologically connected with Delamar Valley as previously discussed, and the perennial yield of Delamar Valley (3000 acre-ft/yr, 3.7 hm^3/yr) and its peak MX demand (679 acre-ft/yr; 0.8 hm^3/yr) is considered, the total peak year demand for construction water in 1984 is 5058 acre-ft (6.2 hm^3/yr) compared to a combined perennial yield of 7000 acre-ft/yr (7.4 hm^3/yr). The combined existing appropriations for the three valleys totals 35 acre-ft/yr (0.04 hm^3/yr), therefore sufficient water would be available from the combined basins to meet peak year MX requirements. It should also be noted that the construction period in the three valleys is from 1982 to 1987, and that the quantity of water needed for the operational phase after that period will be considerably less than that required during construction.

2.8.3.2 Source Capabilities

Surface water is limited to ephemeral steamflow and spring discharges in Dry Lake Valley. The springs in Dry Lake Valley are not believed to be a dependable source of water for the MX project because they are generally in the mountains above the valley floor, are relatively inaccessible, and have low discharge (less than 2 gpm; 0.1 l/s).

Data from an aquifer test performed by Ertec in the southern part of the valley (3S/64E-12ac) indicate a transmissivity and storativity for the valley-fill aquifer of about 3100 ft^2/day (287 m^2/day) and 0.04, respectively. These aquifer characteristics indicate that, in this area of the valley, the valley-fill aquifer is capble of yielding water in sufficeient quantities and rates required to meet MX needs.

A carbonate aquifer test conducted by Ertec Western in the northern part of the valley (3N/63E-27ca) indicated a transmissivity in the carbonate aquifer of about 13,500 ft^2/day (1250 m^2/day) and a specific capacity of 50 gpm/ft.

2.8.3.3 Water Quality

Water quality data for Dry Lake Valley is shown in Appendix F1.8. Chemical analyses of water samples from the two test wells drilled by Ertec Western, one which penetrates the valley-fill aquifer and one which penetrates the carbonate aquifer, one existing well, and six springs indicate that, for the constituents analyzed, water quality are within criteria

for construction water (Appendix E1.1). The chemical analyses of samples from six springs and three wells indicate that all but one well, at 3N/65E-21dba, meet Primary and Secondary Drinking Water Stand ards for the State of Nevada (Appendix E1.2). This well, located in the northeastern portion of the valley was found to have a nitrate concentration of 32 mg/l, which exceeds the 10 mg/l Primary Drinking Water Standards for nitrate. This well was used when the Bristol Silver Mine was in operation and could be contaminated from surface sources. Although the valleywide water quality cannot be accurately predicted from the limited data available, it is expected that the ground water should be suitable for construction and drinking water purposes.

2.8.4 PRIMARY WATER SUPPLY ALTERNATIVES

2.8.4.1 Lease or Purchase of Existing Water Rights

It will not be possible to obtain MX water supplies through the lease or purchase of water rights in Dry Lake Valley because approved and pending ground-water appropriations total only 39 acre-ft/yr (0.05 hm^3/yr). Because of the limited current use, substantial water is available for appropriation.

2.8.4.2 Valley-Fill Aquifer

The valley-fill aquifer represents a satisfactory source of water for MX construction and operation because: a) little ground water in Dry Lake Valley has been appropriated; and b) the aquifer tests and studies performed indicate that it is

capable of supplying water at the rate necessary and insufficient quantity and quality to meet MX requirements.

2.8.4.3 Carbonate Aquifer

The aquifer test mentioned previously indicates that the carbonate aquifer has a high potential for development in Dry Lake Valley. However, it is considered only as alternative for development because the valley-fill aquifer appears adequate for MX water requirements.

2.8.4.4 Interbasin Transfer

Interbasin transfer will not be necessary in Dry Lake Valley because the valley-fill aquifer is capabable of meeting MX requirements. However, the transfer of water from Dry Lake Valley to Muleshoe and/or Delamar valleys is being considered.

2.8.5 IMPACTS OF DEVELOPMENT

2.8.5.1 Intrabasin Effects

Computer simulation of a well field in Dry Lake/Muleshoe withdrawing water for six years at rates estimated by the U.S. Army Corps of Engineers (1981) for both valleys was performed. A transmissivity of 1300 ft^2/day (120 m^2/day) and storativity of 0.05 were used in the simulation. Those values were found to be representative of the average aquifer characteristics of all types of sediments in the valley. Pumping rates were varied according to annual MX needs and reached a maximum of one well pumping in Muleshoe at 600 gpm (38 l/s) and five wells in Dry Lake pumping at 420 gpm (26 l/s). Maximum drawdown effects occurred after five years and averaged about 4.1 feet

(1.2 m) at a distance of one mile (2 km) from the wells in Dry Lake Valley. Because of the lack of vertical recharge on the valley floor and the absense of recharge from underlying sediments, complete recovery after cessation of pumping will occur after at least 30 years.

At the present time ground-water use in Dry Lake Valley consist of widely separated stock watering wells, so MX ground-water withdrawals should be able to avoid significant impacts to these users. The lowered water levels will have no effect on vegetation because the ground water is more than 300 feet (91 m) below the land surface and well beyond all root systems.

There should be little effect on spring discharge in Dry Lake Valley because the majority of the springs are in the hills and mountains and probably discontinuous with the valley-fill aquifer. There is a spring in Dry Lake Valley, (3N/65E-31cc) that may be considered a regional spring connected with the regional flow regime through carbonate rocks. MX wells will be located at appropriate distances from this spring to avoid any impacts.

2.8.5.2 Interbasin Effects

Water levels and spring discharge could be affected in Pahranagat and Delamar valleys because they are downgradient from Dry Lake Valley and receive underflow through the carbonate aquifer. The regional springs which could be affected include Ash, Crystal, and Hiko springs in Pahranagat Valley. However, there is not enough

data available to quantify what, if any, the effects will be. Because of the great distances from the pumped wells, ~~however~~ the effects will probably be undetectable.

2.8.6 MITIGATING MEASURES

A well field design was modeled for Dry Lake Valley which consisted of two simulations, one with a single pumping well and one with five pumping wells. Results from modeling indicate that MX ground-water withdrawals will probably require five or more wells to obtain water in sufficient quantity with the least amount of drawdown. Additonal wells in Dry Lake Valley may be required to meet MX water requirements for Delamar and Muleshoe valleys.

The primary suitable for MX production wells is about 96 mi^2 (249 km^2) along the margin of the valley. The criteria used in determining this area includes consideration of land status, environmentally sensitive areas, existing water appropriations, areas containing Tertiary sediments (which are generally fine grained), and low transmissivity zones.

Pumping schedules could be adjusted to avoid MX construction withdrawals exceeding the perennial yield of Dry Lake Valley. early storage of ground water in reservoirs prior to the construction period is a practical alternative. Another option would be to extend the construction period (reduce the rate of construction), which would reduce the peak year quantity of water required.

There are an additional 71 m^2 (184 km^2) that are considered secondarily suitable in the center of the valley. This area is considered secondary because of the presence of generally low transmissivity lacutrine deposits and/or less than 200 feet of thickness.

DISCHARGE MEASUREMENTS, DRY LAKE VALLEY

ID. NO.	TOWNSHIP RANGE-SECTION	SOURCE	STATION NAME	MO/YEAR MEASURED	DISCHARGE (GPM)	LAND ELEV (FT)	REMARKS	DATA SOURCE
1	3N/65E-31CC	SP		8/1979	3.0	5100		ERTEC 79
2	2N/63E-13CBA	SP	COYOTE SPRING	8/1979	1.0		ERTEC 79	
3	2S/63E-22BC	SP	WHEATGRASS SPR.	5/1980	2.0	5400		ERTEC 80
4	4S/64E-24BA	SP	SEVEN OAK SPR.	5/1980	0.5	5730		ERTEC 80
5	4S/64E-25DD	SP	RED ROCK SPR.	5/1980	1.0	6100	DISCHARGE <1GPM	ERTEC 80

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

ID. NO.	TOWNSHIP RANGE-SECT	SRCE	MO YR	STATION NAME	TEMP DEG C	SP. COND	PH	DISS. SOLIDS	SILICA (SIO2)	CALCIUM (CA)	MAGNESIUM (MG)	SODIUM (NA)
1	3N/63E-27CA	WE	12-30	USAF TEST WELL	--	650	7.3	366	24	76	30	15
2	3N/63E-21DBA	WE	-15	BRISTOL WELL	--	ND	--	--	49	76	33	37
3	3N/65E-31CC	SP	8-79		24.0	470	6.8	--	43	40	10.0	21
4	2N/63E-13CBA	SP	6-79	COYOTE SPRING	20.0	550	6.8	--	79	82	13	49
5	2S/63E-22BC	SP	5-80	WHEATGRASS SPR.	13.0	415	7.0	--	--	--	--	--
6	2S/64E- 28DB	SP	8-79		26.0	443	6.9	--	44	83	10.0	53
7	3S/63E- 5CB	SP	5-80	LITTLE BOULDER SPR.	13.0	250	6.8	--	19	28	7.9	12
8	3S/64E-12AC	WE	4-80	USAF TEST WELL	--	480	7.9	292	1.4	20	10	75
9	4S/64E-24BA	SP	5-80	SEVEN OAK SPR.	8.0	815	7.6	--	--	--	--	--

SELECTED WATER QUALITY DATA FOR DRY LAKE VALLEY

ID. N	POTASSIUM (K)	CARBONATE (CO3)	BICARB. (HCO3)	CHLORIDE (CL)	SULFATE (SO4)	FLUORIDE (F)	NITRATE (N)	BORON (B)	IRON (FE)	MANGANESE (MN)	REMARKS	REFERENCE
	6.5	0	404	5.0	20	.6	ND	--	--	--		ERTEC 80
2	.0	0	137	110	71	--	32	--	--	--	*5	EAKIN 63
3	2.5	0	214	17	21	.2	.4	--	--	--	*1	ERTEC 79
	7.6	0	252	25	25	.5	ND	--	--	--		ERTEC 79
	--	0	351	--	--	--	--	--	--	--		ERTEC 80
	7.1	0	320	30	54	.4	1.4	--	--	--	*1	ERTEC 79
	3.0	0	137	8.0	15	.1	.2	--	--	--	*1	ERTEC 80
8	5.2	1	213	21	44	--	6.7	--	--	--	*1,4	ERTEC 80
9	--	0	303	--	--	--	--	--	--	--		ERTEC 80

NO : SAMPLES FOR WATER QUALITY ANALYSIS COLLECTED BY ERTEC EXCEPT WHERE NOTED. ALL ANALYSIS REPORTED IN MG/L EXCEPT AS NOTED BELOW.
ERTEC ANALYSES FOR DISSOLVED SOLIDS DETERMINED BY RESIDUE -ON- EVAPORATION AT 180 DEGREE C METHOD.
METHODS. NEVADA LOCATIONS BASED ON MT. DIABLO BASELINE. UTAH LOCATIONS BASED ON SALT LAKE BASELINE AND MERIDIAN.

THE FOLLOWING CONSTITUENTS ARE REPORTED IN MICROGRAMS/LITER:
BORON IRON MANGANESE

FOOT *1 NITRATE REPORTED AS N.
NOTES:*2 NITRATE REPORTED AS NO3
*3 NITRITE + NITRATE REPORTED AS N
*4 DISSOLVED SOLIDS BY SUM OF DETERMINED CONSTITUENTS
*5 NA+K AS NA
*6 HCO3+CO3 AS HCO3
ND = NOT DETECTED

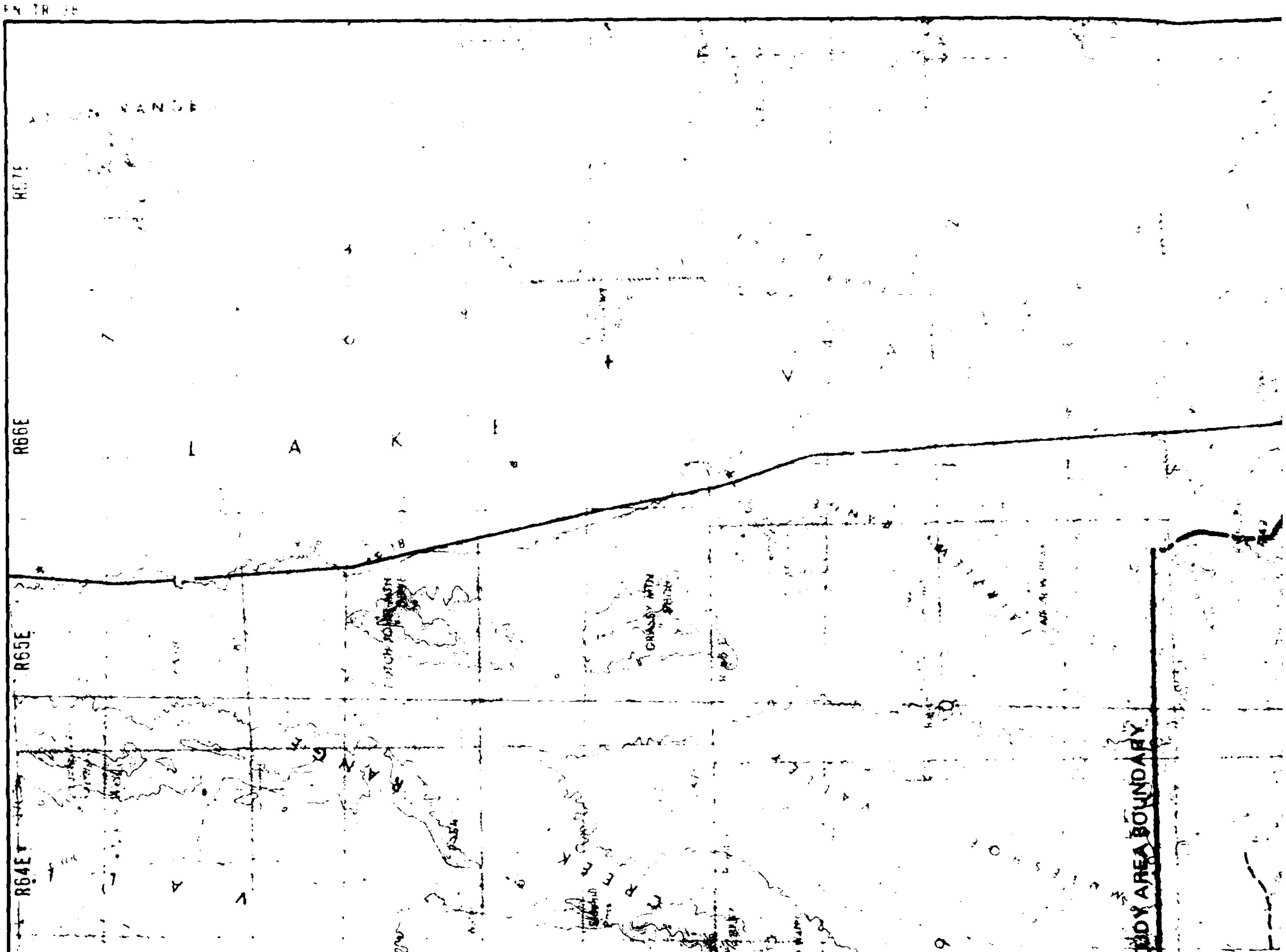
ACTIVITY	82	83	84	85	86	87	88	89	90
1 DOMESTIC									
a LIFE SUPPORT CAMPS		200	593	1179	1000				
b INDEPENDENT WORKERS		1	2	4	4				
2 REVEGETATION		115	995	520	733	250			
3 LANDSCAPING		21	93	125	106				
4 DUST CONTROL									
a ROADWAYS	37	50	311	311	156				
b WORK SITES		40	278	80	40				
c IN CAMPS	-------------------			INCLUDED ABOVE			-------------------		
5 ROAD CONSTRUCTION									
a RECOMPACTION	125		1120						
b CONSTRUCTION ROADS	34		17						
c REGRADING				125					
6 SHELTER EXCAVATION				140	70				
7 CONCRETE FOR DDA			1	23	2				
8 CONCRETE FOR MOB, AOB, DAA, OSTS									
9 CONCRETE AGGREGATE WASH			1	26	2				
*TOTALS (ACRE-FEET / YEAR)	196	427	3411	2533	2133	250			

* These figures are a little higher than those in Table 4 - 13 due to difference in calculations within the COE MX water requirement document, 17 March 1981

MX WATER USE
ESTIMATES
DRY LAKE VALLEY, NEVADA
SEPTEMBER, 81 TABLE

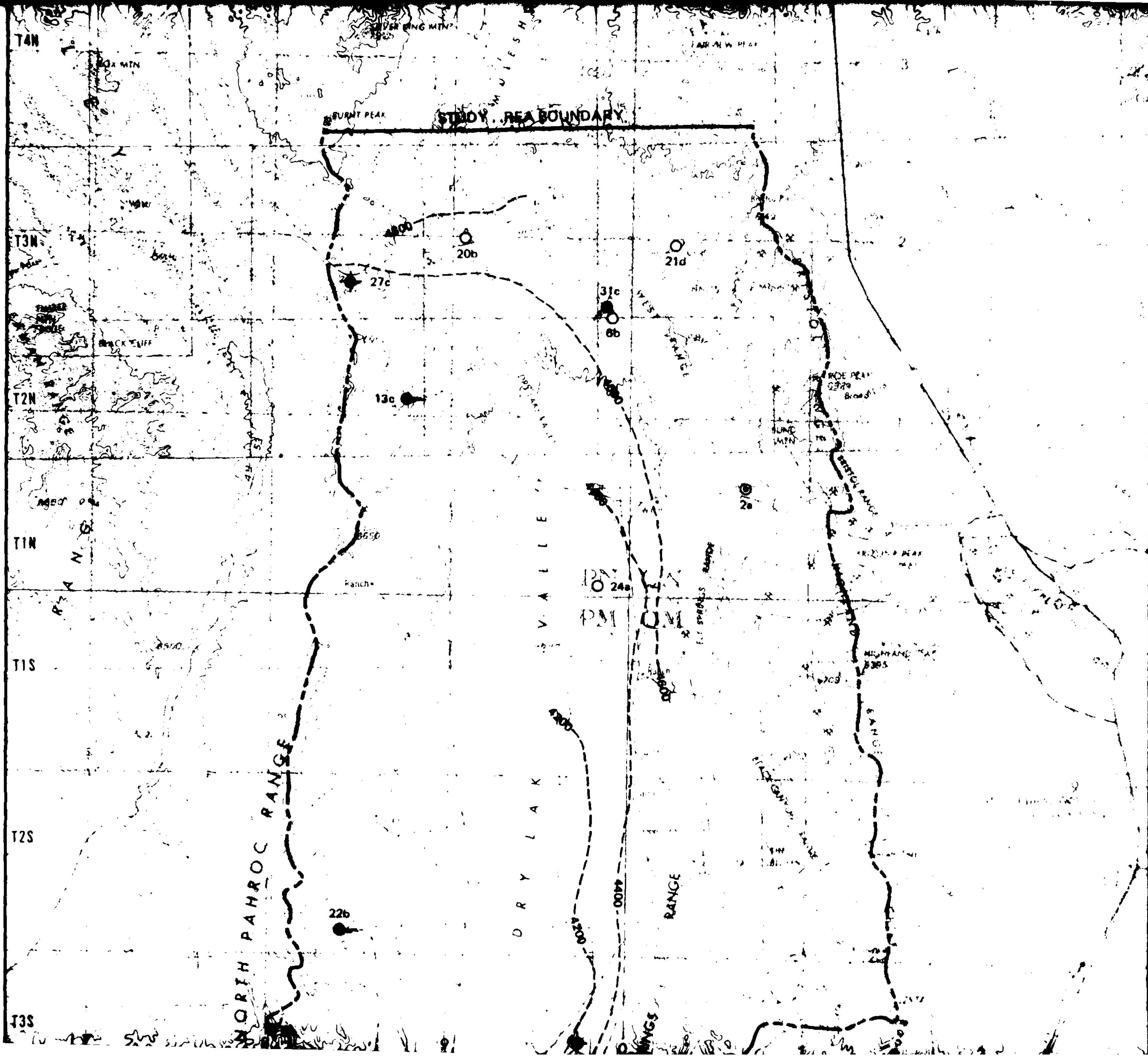
WELL AND WATER LEVEL DATA IN DRY LAKE VALLEY

	WELL DESCRIPTION						WATER LEVEL MEASUREMENTS			REMARKS	DATA SOURCE
ID. NO.	TOWNSHIP RANGE-SECTION	WELL OWNER	YEAR DRILLED	WELL DEPTH (FT)	CASING ID (IN)	LAND ELEV (FT)	MO/YEAR	DEPTH-BELOW SURFACE (FT)	ELEV (FT)		
1	3N/63E-27CA	U.S.AIR FORCE	1980	2395	10	5390	2/1981	851	4539	CARB.TEST WELL	ERTEC
2	3N/64E-20BAC	BLM	1960	380	6	5067	/1960	317	4750		EAKIN 63
3	3N/65E-21DBA	DELMUE	1962	51		5451	/1962	45	5406		USGS 79
4	2N/65E- 6B1			376		5075		--		DRY	EAKIN 63
5	1N/64E-24A1	LYTLE & OTHERS	1959	515	5	4700	1/1959	398	4302		EAKIN 63
6	1N/65E- 2AAC			12	48	5660		10	5650	DUG WELL	EAKIN 63
7	3S/64E-12AC1	U.S.AIR FORCE	1980	1305	2	4645	2/1981	383	4262	OBSERVATION WELL	ERTEC
8	3S/64E-12AC2	U.S.AIR FORCE	1980	1012	10	4645	2/1981	395	4250	TEST WELL	ERTEC

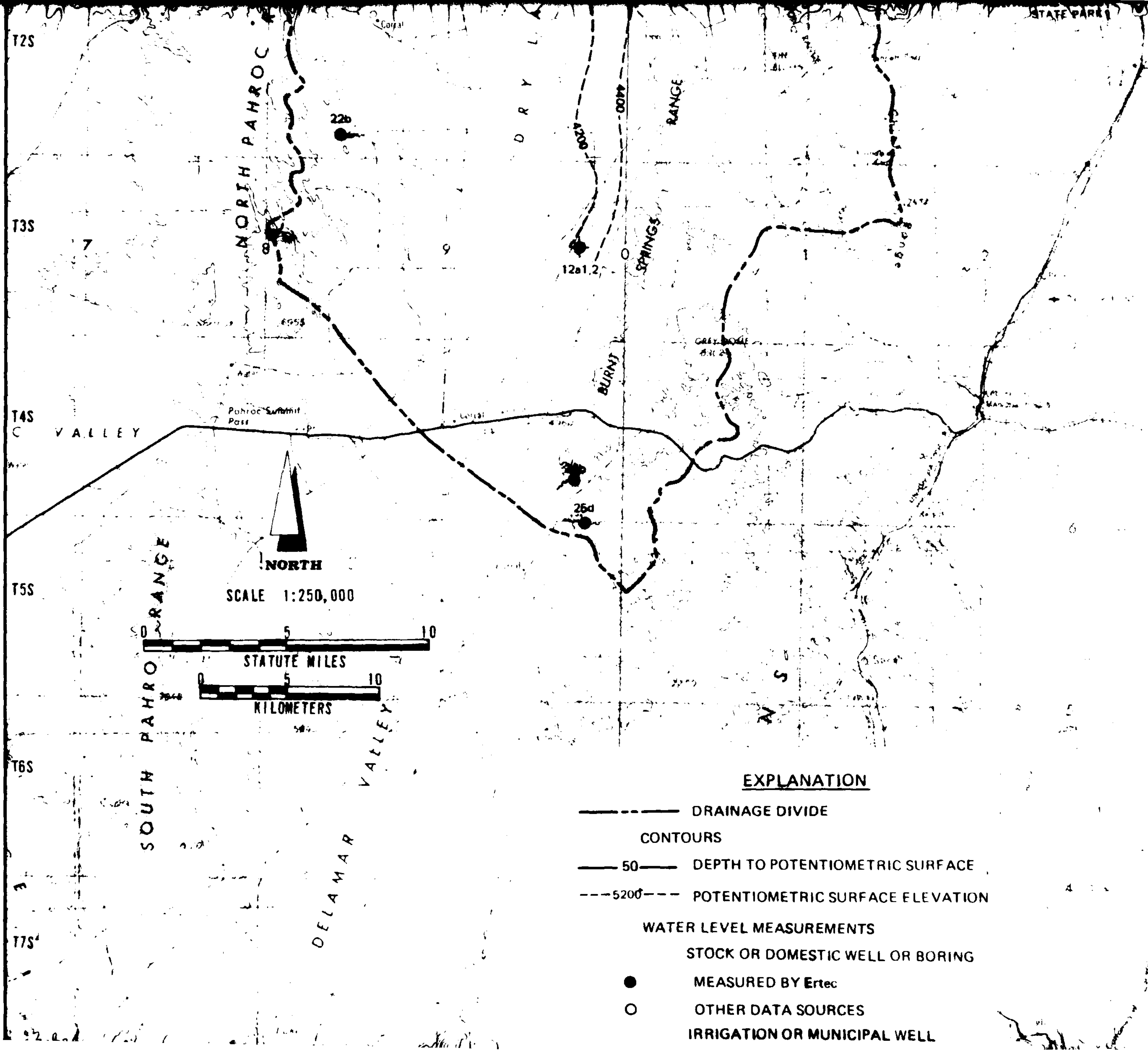


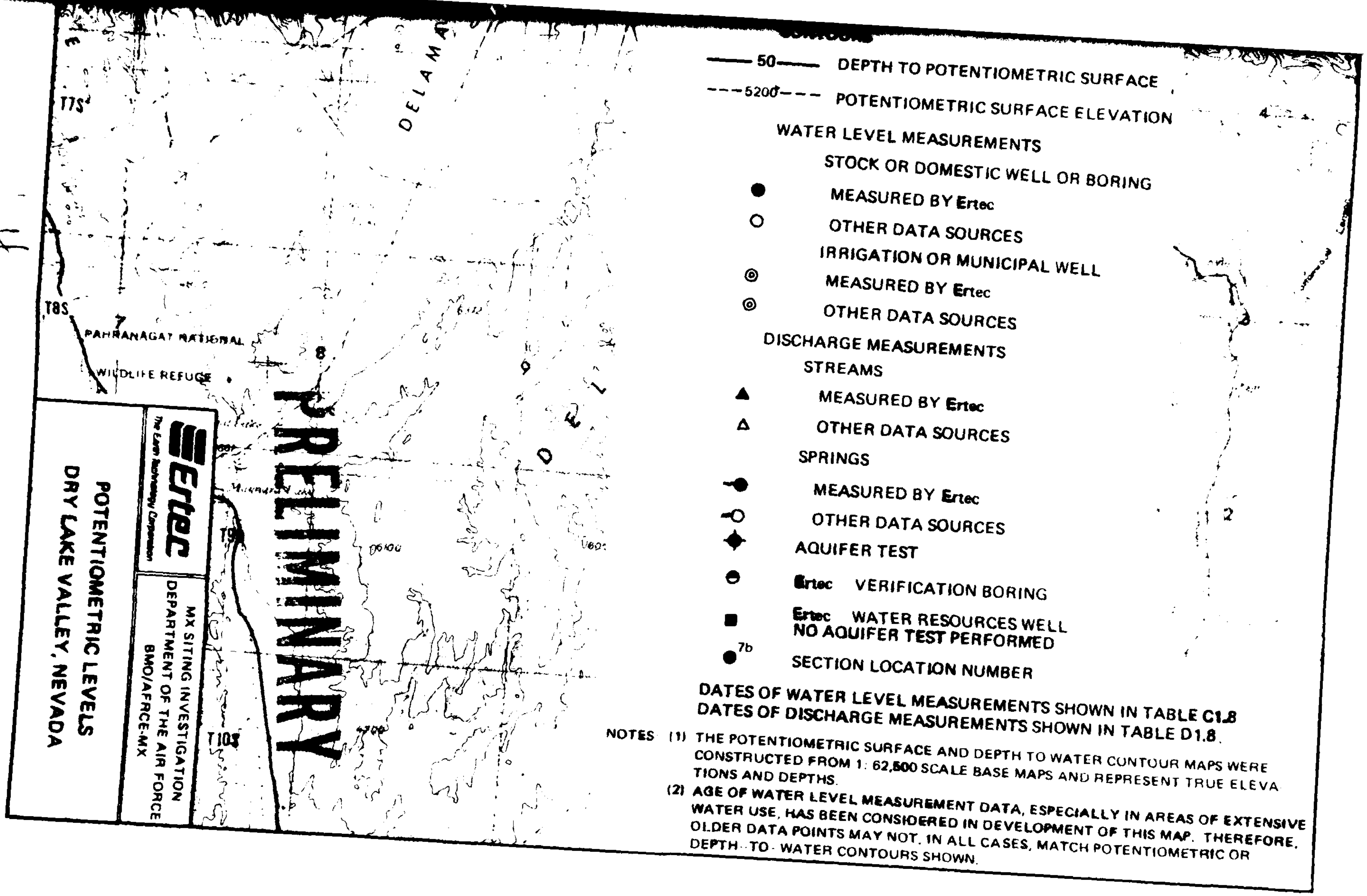
L A K E
STUDY AREA BOUNDARY
R66E
R65E
R64E
R63E
R62E
R61E
T6N
T7N
T6N
T5N
T4N

1 AUG 80

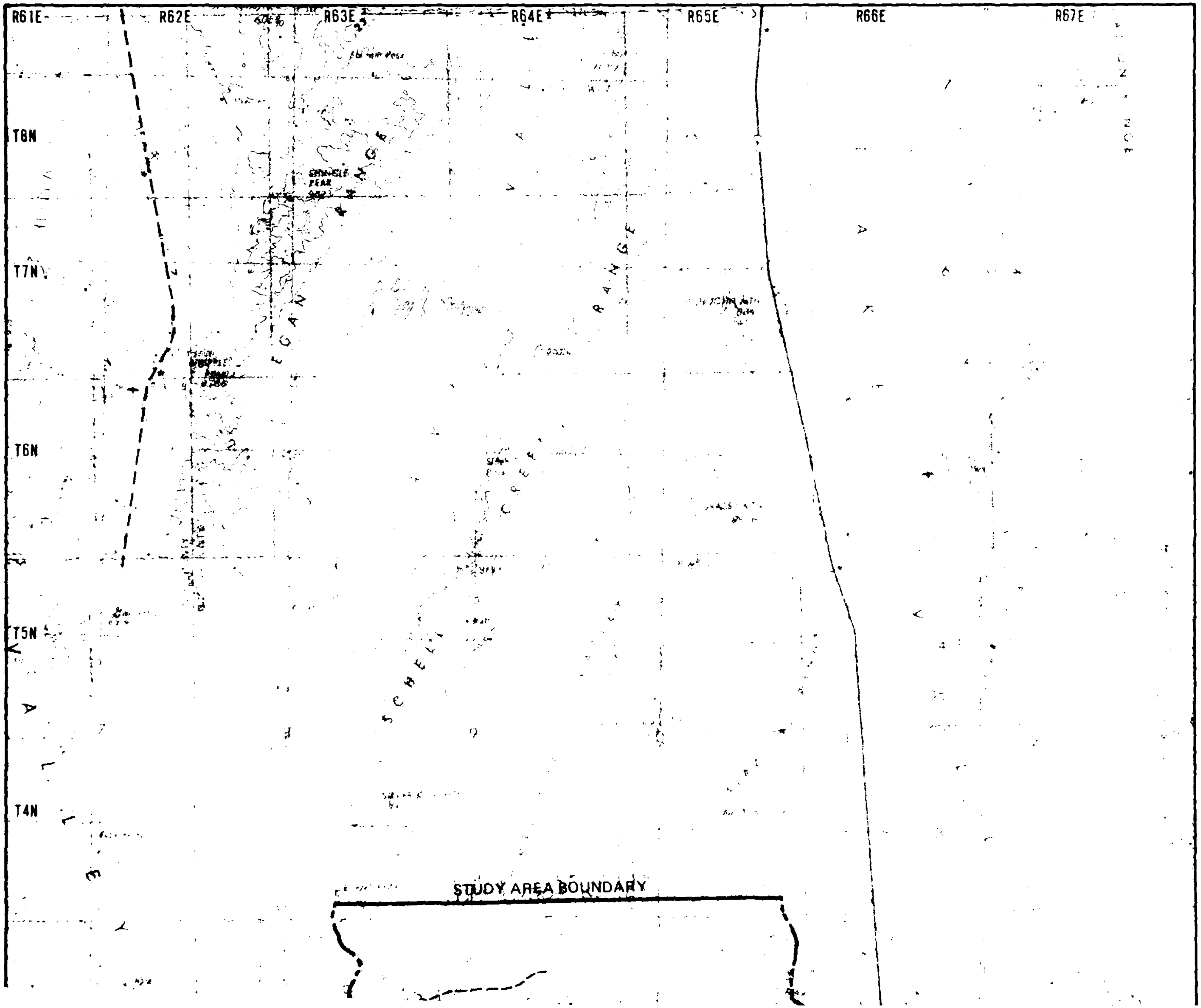

STUDY AREA BOUNDARY
BURNT PEAK
T4N
T3N
T2N
T1N
T1S
T2S
T3S
BOX MTN
BLACK CLIFF
20b
21d
27c
31c
6b
13c
2a
24a
22b
4800
4600
4400
4200
ROE PEAK
BRISTOL RANGE
HIGHLAND PEAK
NORTH PAHROC RANGE
DRY LAK
VALLEY
RANGE
Ranch

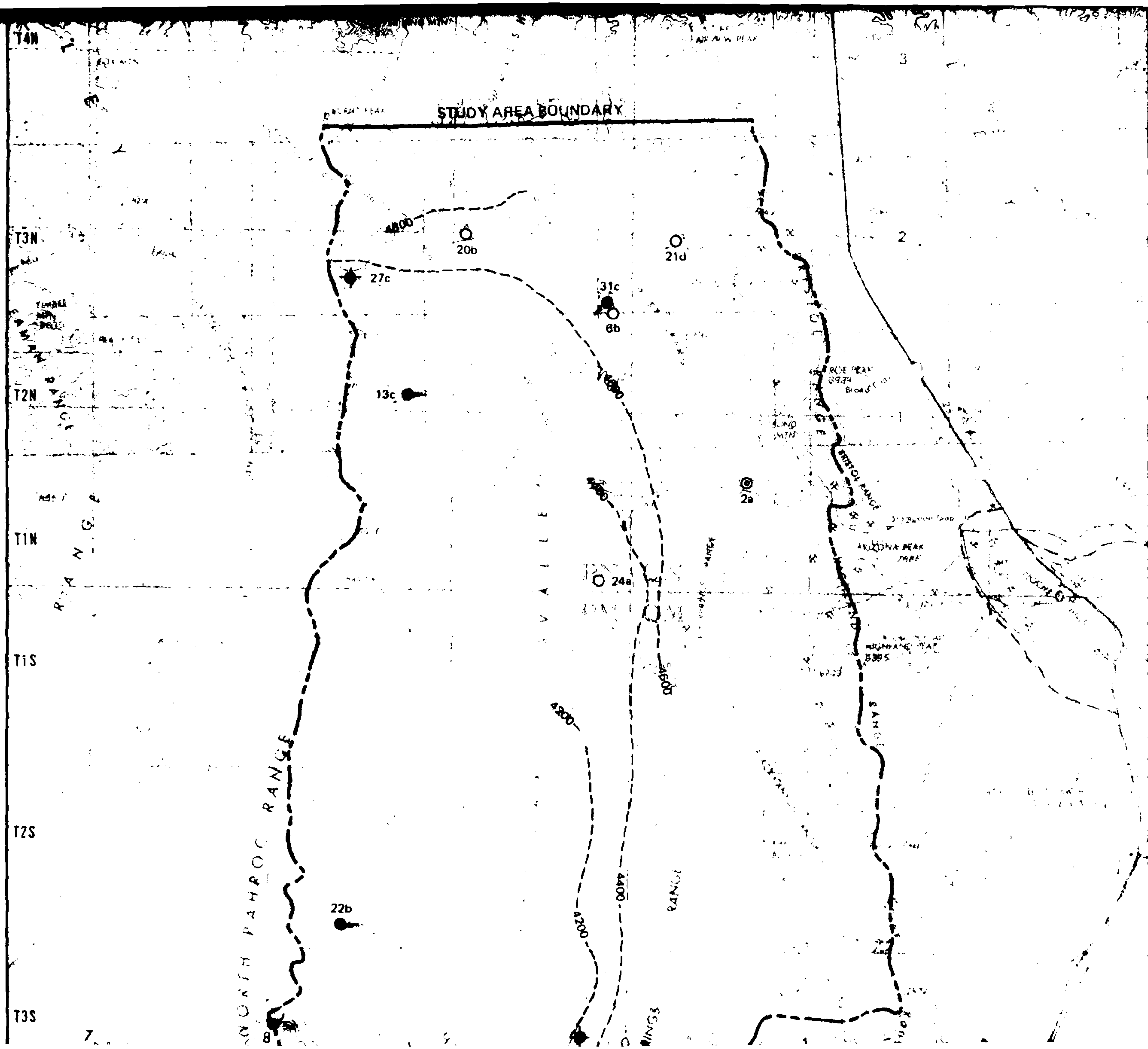
12


STATE PARK
T2S
T3S
T4S
T5S
T6S
T7S
NORTH PAHROC
DRY LAKE
RANGE
SPRINGS
BURNT SPRINGS RANGE
4200
4400
22b
8
12a1,2
25d
Pahroc Summit Pass
VALLEY
SOUTH PAHROC RANGE
DELAMAR VALLEY
NORTH
SCALE 1:250,000
STATUTE MILES
KILOMETERS
0
5
10
EXPLANATION
DRAINAGE DIVIDE
CONTOURS
50
DEPTH TO POTENTIOMETRIC SURFACE
5200
POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL


DELAMAR
T7S
T8S
PAHRANAGAT NATIONAL WILDLIFE REFUGE
T9S
T10S
PRELIMINARY
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL
MEASURED BY Ertec
OTHER DATA SOURCES
DISCHARGE MEASUREMENTS
STREAMS
MEASURED BY Ertec
OTHER DATA SOURCES
SPRINGS
MEASURED BY Ertec
OTHER DATA SOURCES
AQUIFER TEST
Ertec VERIFICATION BORING
Ertec WATER RESOURCES WELL NO AQUIFER TEST PERFORMED
7b SECTION LOCATION NUMBER
DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8.
NOTES (1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE CONSTRUCTED FROM 1: 62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.
(2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE, OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR DEPTH-TO-WATER CONTOURS SHOWN.
Ertec
The Earth Technology Corporation
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX
POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

4

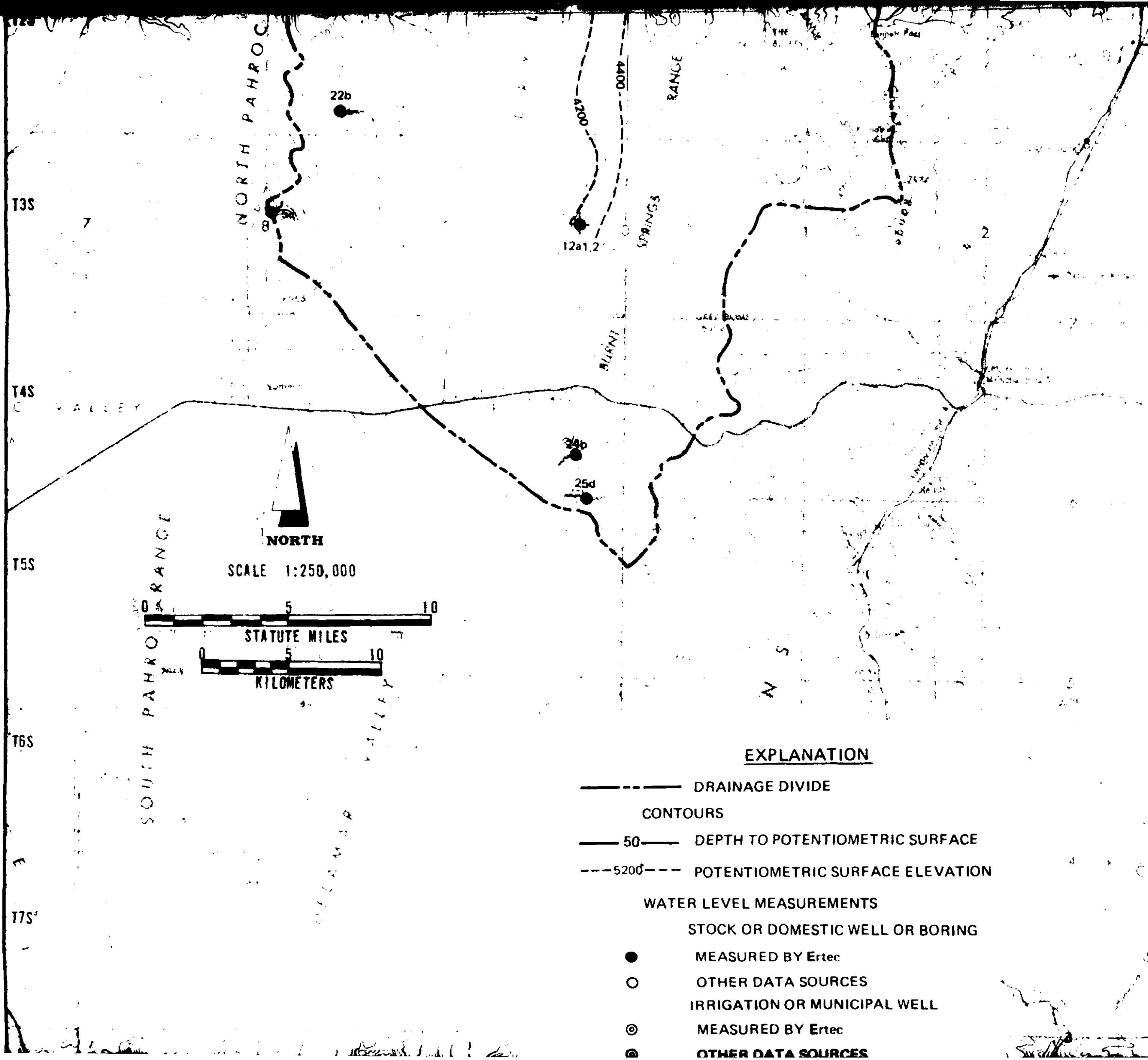

R61E
R62E
R63E
R64E
R65E
R66E
R67E
T8N
T7N
T6N
T5N
T4N
SPINNLE PEAK
STUDY AREA BOUNDARY



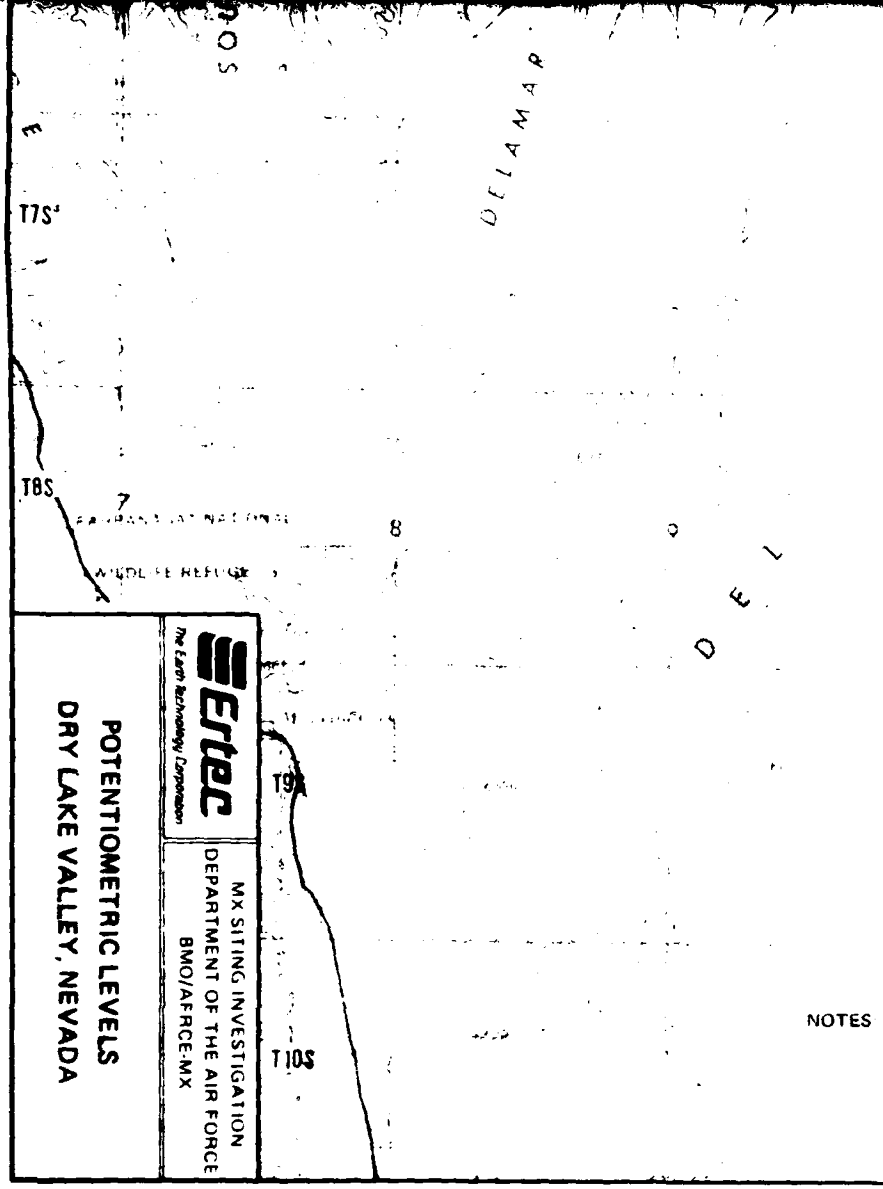
STUDY AREA BOUNDARY
T4N
T3N
T2N
T1N
T1S
T2S
T3S
4800
4600
4400
4200
20b
21d
27c
31c
6b
13c
2a
24a
22b
8
BRISTOL RANGE
ARIZONA PEAK
NORTH PAHROC RANGE
VALLEY
2
3

12

13



T3S
T4S
T5S
T6S
T7S
NORTH PAHROC
SOUTH PAHROC RANGE
RANGE
SPRINGS
BURNT
VALLEY
4400
4200
22b
8
12a1.2
24b
25d
NORTH
SCALE 1:250,000
0 5 10
STATUTE MILES
0 5 10
KILOMETERS
EXPLANATION
DRAINAGE DIVIDE
CONTOURS
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
STOCK OR DOMESTIC WELL OR BORING
MEASURED BY Ertec
OTHER DATA SOURCES
IRRIGATION OR MUNICIPAL WELL
MEASURED BY Ertec
OTHER DATA SOURCES



DRAINAGE DIVIDE

CONTOURS

—— 50 —— DEPTH TO POTENTIOMETRIC SURFACE

- - - 5200 - - - POTENTIOMETRIC SURFACE ELEVATION

WATER LEVEL MEASUREMENTS

STOCK OR DOMESTIC WELL OR BORING

● MEASURED BY Ertec

○ OTHER DATA SOURCES

IRRIGATION OR MUNICIPAL WELL

◎ MEASURED BY Ertec

◎ OTHER DATA SOURCES

DISCHARGE MEASUREMENTS

STREAMS

▲ MEASURED BY Ertec

△ OTHER DATA SOURCES

SPRINGS

MEASURED BY Ertec

OTHER DATA SOURCES

AQUIFER TEST

Ertec VERIFICATION BORING

■ Ertec WATER RESOURCES WELL NO AQUIFER TEST PERFORMED

● 7b SECTION LOCATION NUMBER

DATES OF WATER LEVEL MEASUREMENTS SHOWN IN TABLE C1.8
DATES OF DISCHARGE MEASUREMENTS SHOWN IN TABLE D1.8.

NOTES

(1) THE POTENTIOMETRIC SURFACE AND DEPTH TO WATER CONTOUR MAPS WERE CONSTRUCTED FROM 1:62,500 SCALE BASE MAPS AND REPRESENT TRUE ELEVATIONS AND DEPTHS.

(2) AGE OF WATER LEVEL MEASUREMENT DATA, ESPECIALLY IN AREAS OF EXTENSIVE WATER USE, HAS BEEN CONSIDERED IN DEVELOPMENT OF THIS MAP. THEREFORE, OLDER DATA POINTS MAY NOT, IN ALL CASES, MATCH POTENTIOMETRIC OR DEPTH TO WATER CONTOURS SHOWN.

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

E1.0

DRY LAKE/DELAMAR VALLEYS SECTION: MX SITING INVESTIGATION, WATER RESOURCES PROGRAM, SUMMARY FOR DRAFT ENVIRONMENTAL IMPACT STATEMENT

north of township 6 with total dissolved solids concentrations ranging from about 130 to about 280 mg/l. Two springs (7N/64E-33cc; 6N/63E-19da), analyzed by the BLM have moderately high bicarbonate concentrations (more than 250 mg/l). This condition is probably due to the solution of carbonate rocks by the ground water.

Cave Valley Spring located at 9N/64E-16bdb also originates from the carbonates but has low bicarbonate concentration (80 mg/l) and low total dissolved solid concentrations (127 mg/l). This is probably due to a short resident time of the ground water with the rocks which suggests that it is related to precipitation and snowmelt. Thus it is not connected to the regional carbonate aquifer. The discharge in Cave Spring ranges from a few hundred gallons per minute to less than 10 gallons per minute. Table C1-3 lists the chemical analysis of the water samples and Drawing D1-2 shows the area of good water quality. As can be seen on the Drawing, all of the valley is estimated to contain ground water of good quality.

3.3 DRY LAKE/DELAMAR VALLEYS

3.3.1 Physiography and Geology

Dry Lake and Delamar valleys are believed to be hydrologically connected through valley-fill aquifers and are treated essentially as the same ground-water basin in the ensuing discussions. The Dry Lake/Delamar drainage basin lies within central Lincoln County in east-central Nevada (Figure 1). The basin is approximately 82 miles (132 km) long and 20 miles (32 km) wide at the

widest point, and encompasses an area of 1300 mi^2 (3367 km^2). Of that area, 497 mi^2 (1287 km^2) are suitable for MX siting including 315 mi^2 (815 km^2) in Dry Lake Valley and 182 mi^2 (417 km^2) in Delamar Valley.

The valley-fill deposits are up to 10,000 feet (3 km) thick along the axis of the valleys and thin toward the margins. Based on detailed gravity maps constructed by Fugro National, (FN-TR-33-DL), the volume of valley-fill in Dry Lake Valley is estimated to be 635,000,000 acre-ft (732,955 hm^3). The estimated volume of valley-fill in Delamar Valley is 200,000,000 acre-ft (246,600 hm^3). These substantial potential aquifer volumes provide tremendous storage capacity for ground water.

Mountain crests bounding the valleys range in elevation from about 7000 feet (2134 m) to over 9000 feet (2743 m). Highland Peak, on the east side of Dry Lake Valley, has an elevation of 9395 feet (2864 m), and is the highest point in the basin. The playa, in the extreme south end of Delamar Valley, has an elevation of less than 4400 feet (1341 m) and is the lowest point in the basin. The two valleys are separated by a low, broad alluvial fan that extends across the basin just south of Dry Lake playa.

Dry Lake and Delamar valleys exhibit typical Basin and Range structure, consisting of high angle, north-south trending, normal basement faults that border the Pahroc ranges on the west and the Bristol, Highland, Chief, and Delamar ranges on the east. The area between the ranges is faulted downward. A

north-south trending fault on the eastern side of the basin displaces surface alluvium and forms a prominent scarp. Additionally, Shawe (1965) shows east-west trending faults that transect the basin and displace deep valley-fill deposits. This interpretation is supported also by gravity surveys (Fugro National, FN-TR-26E).

The mountains on the western side of the valley are predominantly composed of ash flow tuffs of Tertiary age with some carbonate rocks of Paleozoic age. Conversely, the eastern mountains are composed primarily of carbonate rocks of Paleozoic age with minor amounts of ash flow tuffs of Tertiary age (Stewart and Carlson, 1978).

Coarse-grained alluvial and fine-grained lacustrine deposits make up the majority of sediments in the valleys. Although playa deposits cover only a small percentage of the valley surface, they are thought to be of great thickness and interfinger with alluvial deposits in the subsurface (Fugro National, FN-TR-27). These playa deposits are located in the south-central portions of the valleys. From the central part of the valleys, the grain size and grading of alluvial deposits progressively increase towards the mountains.

3.3.2 General Hydrology

Dry Lake and Delamar valleys form closed surface drainage basins. There are no perennial streams in the valleys, and streamflow only occurs in the mountain ravines and alluvial fans after high-intensity rains and as snowmelt runoff.

Springs in the Dry Lake and Delamar valley area occur in volcanic rocks composed predominantly of tuffs along the basin margins. The springs are recharged by meteoric waters (precipitation and snowmelt) and are not associated with the deep regional carbonate aquifer. They generally have low yields (less than 20 gpm) and are used primarily to supply stock ponds in the area.

The ground-water table in the basin aquifer occurs at considerable depths (Drawings B1-3 and B1-4). In Dry Lake Valley, ground-water levels are about 400 feet (122 m) below ground surface, and in Delamar Valley, levels are generally greater than 800 feet (244 m) below ground surface. Some water wells in the northern and western part of Dry Lake Valley tap perched aquifers with water levels significantly higher than the underlying basin aquifer. Water use in the valleys is limited to a few isolated stock ponds fed by infrequent surface runoff and nearby springs with waters of meteoric origin.

Ground-water recharge to the basin is primarily from precipitation occurring in the mountains along the northwest and east flanks of the valleys (Eakin, 1963). From these areas, ground water moves laterally and downward toward the central part of the valleys as indicated on the ground-water level contour map (Drawing B1-3 and B1-4). Generally, the ground water moves from Dry Lake Valley toward Delamar Valley. An annual (recharge based on a percentage of average annual precipitation) of about 6000 acre-ft (7.4 hm^3) for the valleys has been estimated by

Eakin (1963). Discharge occurs primarily as deep underflow to the south through carbonate rocks. Alluvial ground-water gradients between Dry Lake Valley and Delamar Valley closely resemble the carbonate aquifer gradient between White River Valley and Pahranagat Valley. This suggests that the valley-fill aquifers of the basin and the regional carbonate aquifers are hydraulically connected (Eakin, 1963).

3.3.3 Aquifer Characterisitics

The considerable depth to ground water (Drawing B1-3 and B1-4) has precluded much development in these valleys and, therefore, very little has been published about specific aquifer characteristics. However, all wells in the basin tap valley-fill aquifers with little indication of confinement. Existing wells produce less than 100 acre-ft of water annually for use by livestock. During Furgo National's field investigations in 1979, none of the wells were found to be suitable for aquifer testing because of pumping limitations. In 1980, two intermediate depth test wells (3S/64E-12ca and 6S/63E-12ad) were drilled in Dry Lake/ Delamar valleys (lithologic and geophysical logs are presented in Appendices H1-3 and H1-34). At each site, observation and test wells were constructed.

Aquifer tests in Dry Lake Valley were conducted for ten days at 500 gpm (31.5 l/s) followed by an aquifer recovery test. The maximum well yield during development was approximately 750 gpm (47.3 l/s). Maximum drawdown at the pumping well during the pump test was about 50 feet (15 m). These tests indicated an

aquifer transmissivity of about 45,000 gpd/ft (155 cm^2/sec) and a storage coefficient of 3×10^{-4}. Because the well only partly penetrated the aquifer, the transmissivity of the total thickness of the aquifer is probably much higher. The unusually low storage coeffiecient in the valley-fill aquifer is probably due to the tremendous thickness of the aquifer.

Aquifer tests in Delamar Valley were conducted for ten days at 85 gpm (5.3 l/s) followed by an aquifer recovery test. Maximum drawdown during the test was 85 feet (26 m). Transmissivity was calculated at 5000 gpd/ft (7 cm^2/sec) with a storage coefficient of 4.0×10^{-4}.

Potential well yields in Dry Lake Valley are expected to be high in the unconsolidated valley-fill deposits around the valley periphery. However, a significant portion of the basin is probably composed of fine-grained lacustrine deposits near the central valley areas. These areas probably have relatively low hydraulic conductivities. The extent and depth of the low yield deposits are not fully known. However, there appears to be sufficient water for development of the MX system within the basin.

Because of the great depths to water in Delamar Valley [870 ft (265 m) in test well 6S/63E-12ad], well yields are expected to be less than 100 gpm (6.3 l/s). Well yields may increase slightly away from the central valley axis, but any yield increase due to higher aquifer permeability will probably be offset by the corresponding increase in pumping lift.

3.3.4 Water Quality Limitations

Because there are very few wells in Dry Lake Valley, only four ground-water quality analyses are available. The well and spring sample locations are shown in Drawing D1-3. Four of these samples were collected by Fugro National in 1979 and 1980 and one sample was collected by Carpenter (1915) and reported by Eakin in 1963.

Based on the water quality critieria listed in Appendix C1-1, all of the water analyzed is of good quality and is acceptable for drinking. All ground-water samples contained moderately high bicarbonate levels ranging from 187 to 320 mg/l, which result in hardness levels of about 100 mg/l. Calcium concentrations range from about 40 to 83 mg/l and were generally in the poor range. In addition, the sample collected at 3N/65E-21dbd and analyzed by Carpenter also contained relatively high chloride (110 mg/l) and nitrate (32 mg/l) concentrations.

Ground water in the northern part of Dry Lake Valley is of the calcium-magnesium/chloride-bicarbonate type. As the ground water migrates from the fans toward the central valley area, the concentrations of calcium and chloride increase slightly and sodium concentrations decrease, yielding water of the sodium-calcium/bicarbonate type. The higher calcium and chloride concentrations in the central valley area may be related to the soil chemistry of the playa deposits.

The only ground-water samples for chemical quality testing from Delamar Valley was from the Fugro National test well. However,

the analyses were not completed at the time of publication of this report.

3.4 DUGWAY VALLEY

3.4.1 Physiography and Geology

Dugway Valley is located in Tooele and Juab counties in west-central Utah (Figure 1) and has a total area of 890 mi^2 (2300 km^2). Of the total area only 182 mi^2 (471 km^2) are suitable for MX siting.

Dugway Valley trends north-south and is approximately 30 miles (48 km) long and varies in width from 1 to 8 miles (2 to 13 km). The valley is bordered on the west by the Dugway Mountains and the Thomas Range, on the south by the Drum Mountains, and on the east and northeast by Keg Mountain and Slow Elk Hills. The northern boundary of the valley is the Great Salt Lake Desert. Valley floor elevations range from 4480 feet (1365 m) at the north end to 5080 feet (1548 m) in the central-southern portion of the valley. The valley is bounded by peaks on the northwest that reach elevations of nearly 9000 feet (2700 m). Most of the area below about 4600 feet (1400 m) is nearly flat as a result of planation and deposition by ancient Lake Bonneville (Stephens and Sumsion, 1978).

Valley-fill deposits consist mainly of alluvial fan deposits along the margins of the valley which interfinger with lake and playa deposits in and near the center of the valley. These deposits consist mainly of clay, silt, sand, and minor amounts

FUGRO WELL CONSTRUCTION

WELL NO DD-2 — SHEET 1 OF 1

LOGGED BY JFO, SC AND LB — PROJECT NO 79-290-45

DATE (S) JAN 3-22, 1980 — PROJECT NAME MX

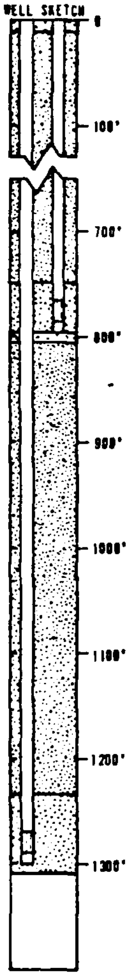
VALLEY DRY LAKE

ELEVATION

GROUND LEVEL 4843'

LOCATION OR COORDINATES 3S/84E-12ca — TOP OF CASING 4845'

WELL SKETCH



DRILLING SUMMARY

TOTAL DEPTH DRILLED 1305'

ROTARY REVERSE — CORE

DRILLING CONTRACTOR DEYLIN

RIG (S) USED BUCKET AUGER 0' TO 40'; 40' TO TD REVERSE ROTARY

SIZE (S) AND TYPE (S) OF BITES 18 5/8" DRAG AND CLUSTER BITS

DRILLING FLUID WATER AND 4 SACKS POLYMER

SAMPLING METHOD COLLECTED FROM DISCHARGE PIPE

SURFACE CASING 0' TO 40' 22" DIA

COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG
GEOLOGIC LOG ✓
GEOPHYSICAL LOG ✓
COPIES ATTACHED ___ YES ___ NO

STEEL CASING STRING 1

FROM	TO
0'	1270 BLANK
1270'	1290' PERF
1290'	1300' BLANK

STEEL CASING STRING 2

FROM	TO
0'	765' BLANK
765'	785' PERF
785'	795' BLANK

	STEEL	PVC
CASING DIMENSIONS	2" I D	
SCREEN DIMENSIONS	2" I D	
SLOT SIZE	3/4" MACHINED SLOTS	

PACKERS

CENTRALIZERS

PEA GRAVEL 0'-750' 805'-1230'

WELL PACK 750'-785' 1230'-1305

CEMENT (MIX) ___ DEPTH (S) 0' - 10'; 795'-805'

BENTONITE
PELLETS
SLURRY

DEVELOPMENT METHOD (S)

AIR LIFT 19 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOPMENT				

MISCELLANEOUS

A 22" DIAMETER STEEL CONDUCTOR CASING WAS INSTALLED TO 40' BELOW THE GROUND SURFACE

F-6-3 2-21-79

EXPLANATON

- BLANK CASING
- PERFORATED CASING
- CEMENT
- GRAVEL PACK
- SAND PACK

WELL CONSTRUCTION LOG
OBSERVATION WELL
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE H1.4-3

FUGRO NATIONAL, INC.

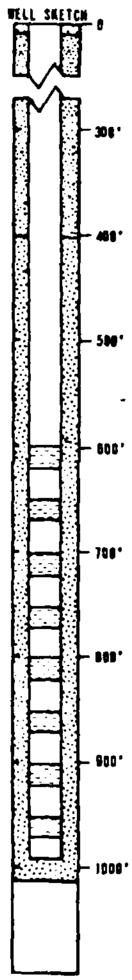
FUGRO WELL CONSTRUCTION

WELL NO TW-1 SHEET 1 OF 1
LOGGED BY JFM, LB PROJECT NO 78-299-45
DATE (S) JAN. 29-FEB 12,1980 PROJECT NAME MX
VALLEY DRY LAKE

ELEVATION
GROUND LEVEL 4843'

LOCATION OR COORDINATES 3S/64E-12cb TOP OF CASING 4846'

WELL SKETCH



DRILLING SUMMARY

TOTAL DEPTH DRILLED 1010'
ROTARY REVERSE CORE
DRILLING CONTRACTOR LEYLIN

RIG (S) USED BUCKET AUGER 0'-40'
REVERSE ROTARY 40'-TD
SIZE (S) AND TYPE (S) OF BITES 18 5/8" DRAG
TRICONE & CLUSTER BITS
DRILLING FLUID POLYMER (5 SACKS) AND WATER

SAMPLING METHOD COLLECTED FROM DISCHARGE PIPE
SURFACE CASING 0'-40' 22" DIAMETER
COMMENTS (PROBLEMS, SHUTDOWNS, ETC)

DESIGN

BASIS DRILLER'S LOG
GEOLOGIC LOG ✓
GEOPHYSICAL LOG ✓
COPIES ATTACHED __ YES __ NO

STEEL CASING SCREEN

FROM 600' TO 620'
FROM 650' TO 670'
FROM 700' TO 720'
FROM 750' TO 770'
FROM 800' TO 820'

FROM 850' TO 870'
FROM 900' TO 920'
FROM 950' TO 970'
FROM TO
FROM TO

CASING	STEEL	PVC
DIMENSIONS	10" I.D.	
SCREEN		
DIMENSIONS	10" I.D.	
SLOT SIZE	80	

PACKERS

CENTRALIZERS EVERY 100'

PEA GRAVEL 10-400'
WELL PACK 400'-1010
CEMENT (MIX) DEPTH (S) 0'-10'

BENTONITE
PELLETS
SLURRY

DEVELOPMENT METHOD (S)

SWABBING AND BAILING, 32 HOURS,
PUMP SURGING FOR 12 HOURS

TIME LOG

	START	FINISH	ELAPSED TIME	% OF TOTAL
DRILLING				
LOGGING				
CASING				
GRAVEL PACKING				
CEMENTING				
BENTONITE PELLETS				
SLURRY				
DEVELOPMENT				

MISCELLANEOUS

10" I.D. BLANK CASING INSTALLED ABOVE AND BELOW EACH SCREENED INTERVAL. A 22" DIAMETER STEEL CONDUCTOR CASING WAS INSTALLED AND GROUTED TO 40' BELOW THE GROUND SURFACE

F-8-2 2-21-78

EXPLANATION

- BLANK CASING
- PERFORATED CASING
- CEMENT
- GRAVEL PACK
- SAND PACK

WELL CONSTRUCTION LOG
TEST WELL
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE H1.4-4

FUGRO NATIONAL, INC.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

(4)

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12ac ~~ca~~

EQUIPMENT USED 0-40' Bucket Auger/ ~~90-1300' Reverse Ro~~tary

LOGGED BY JM & SC DATE 1-8-80

COMPANY Beylik

CHECKED BY JAG DATE 4-10-80

OPERATOR Jim Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	Silt: Tan silt with occasional gravel to 1½".
10	Silt: Tan Silt
20	Silt & Sand with Gravel: Tan silt with ± 25% med colored, fine to coarse, ± poorly sorted, subrounded to subangular sand, with ± 10% med colored subrounded to angular gravel to 1½".
30	Gravel with Cobbles - Med to dark colored, subrounded to subangular ½" gravel up to cobbles to 4".
40	Fine Gravel with Sand: Brown color, well sorted, subrounded gravel with less than 25% coarse sand, gravel up to 3/4".
50	Gravel with Coarse Sand: Brown color, subangular, well sorted gravel up to 3/4" with coarse, angular sand (less than 25%).
60	Gravel with Sand: Brown color, well sorted, subrounded gravel up to 1½" with less than 25% coarse sand.
70	Gravel with Sand: Same as above (60').
80	Coarse Sand with Gravel: Dark color, well sorted, subrounded sand with less than 25% gravel up to ½".
90	Fine to Medium Gravel with Sand: Brown color, well sorted, subrounded gravel with less than 10% coarse sand.
100	Gravel with Sand: Dark color, well sorted, subangular gravel up to 3/4" with less than 30% coarse sand.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Circulation
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T35, R64E, Sect. 12 ~~ca~~ ac
LOGGED BY S C & JM DATE 1-8-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	Gravel with Coarse Sand: Dark color, well sorted, subangular, max gravel 1" with less than 25% coarse sand.
110	Gravel with Coarse Sand: Same as above (100'-110'). Max size for gravel ½".
120	Gravel with Coarse Sand: Same as above (100'-120'). Max gravel 1½".
130	Gravel with Coarse Sand: Less than 25% sand. Max gravel 1½". *Most less than 1".*
140	Gravel with Coarse Sand: Less than 10% sand. Same as above (130-140').
150	Gravel with Coarse Sand: Dark, subrounded, well sorted max size 1" gravel with less than 40% very coarse, subangular sand.
160	Gravel with Coarse Sand: Brown, subrounded, well sorted gravel with less than 25% coarse sand. Max size 3/4".
170	Gravel with Coarse Sand: Brown, subangular, well sorted gravel with less than 25% coarse sand. Max size 3/4".
180	Gravel with Coarse Sand: Much coarser than 170-180', 33% of sample greater than 1" size. Brown subrounded, subangular, well sorted with less than 10% sand.
190	Very Coarse Gravel with Coarse Sand: Dark, well sorted subangular. Greater than 2" sized gravel. Less than 5% coarse sand.
200	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Circulation
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12 ~~ea~~ 6
LOGGED BY JM & SC DATE 1-8-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	Gravel with Coarse Sand: Brown, well sorted, subangular gravel. Max size 1" with less than 40% subangular, coarse sand.
210	Gravel with Coarse Sand: Gray, subangular, well sorted. Max size 1½". Less than 10% subangular, coarse sand.
220	Gravel with Coarse Sand: Gray-black, subangular, well sorted. Max size 2½". Less than 10% coarse, subangular sand.
230	Gravel with Coarse Sand: Gray-black, subangular, well sorted. Max size 1". Less than 40% subrounded, coarse sand.
240	Gravel with Sand and Some Clay: Subangular, poorly sorted, max gravel size 3/4". Less than 10% sand. Less than 20% silt and clay.
250	Gravel with Coarse Sand: Gray-brown, subangular, well sorted, max size 1". Less than 20% coarse sand.
260	Gravel with Coarse Sand: Gray, subangular, well sorted. Max size 2½" gravel. Less than 20% coarse, subangular sand.
270	Gravel with Sand and Silt: Gray color, subangular, poor to medium sorted, max ½" gravel. Less than 25% fine- to coarse-grained sand. Less than 5% silt.
280	Gravel with Coarse Sand: Gray color, subangular, well sorted. Max 3/4" gravel. Less than 20% coarse, subangular sand.
290	Gravel with Coarse Sand: Gray, subangular, well sorted, max size gravel 1". Less than 20% subangular coarse sand.
300	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Circulation

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12

LOGGED BY JM & SC DATE 1/8/80

CHECKED BY JAG DATE 4/10/80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	Fine Gravel with Coarse Sand: Gray-brown, subrounded, well sorted, max size ½". Less than 40% coarse, subrounded sand.
310	
320	Gravel with Coarse Sand: Gray-brown, subrounded, well sorted, max size ½" gravel, less than 40% coarse, subrounded sand.
	Gravel with Coarse Sand: Well sorted, brown gray, subrounded, max ½" gravel with less than 30% coarse, subrounded sand.
330	
340	Gravel with Sand, Silt & Clay: Poorly sorted, gray-black, subangular to subrounded, less than 40% sand. Less than 10% silt and clay, ½" gravel.
350	Gravel with Sand, Silt & Clay: Poorly sorted, brown subangular-subrounded. 40% sand, 10% silt and clay, ½" gravel.
360	Gravel with Trace Sand, Silt & Clay: Less than 20% sub-gravel size, gray-black, subangular, poorly sorted ½" gravel.
370	Gravel with Medium to Coarse Sand: Brown-black, subrounded-subangular well sorted less than 30% sand.
380	Gravel: Poorly sorted, ½" gravel, subangular, less than 20% coarse sand.
390	Gravel: Medium sorted, gray-black-brown, subangular, less than 10% sand, ½" gravel.
400	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45

VALLEY NAME Dry Lake

PROJECT NAME MX SITING INVESTIGATION

LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac

EQUIPMENT USED Reverse Circulation

LOGGED BY JM & SC DATE 1/14/80

COMPANY Beylik

CHECKED BY JAG DATE 4/10/80

OPERATOR J. Clyde

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	Gravel with Sand, Silt & Clay: Poorly sorted, gray-black, subangular-subrounded, less than 30% sand, 20% silt and clay, ½" gravel.
410	Gravel with Sand, Silt & Clay: Poorly sorted, subangular to subrounded, gray-black, less than 20% sand, less than 10% silt and clay.
420	Gravel with Sand, Silt & Clay: Poorly sorted, subangular, brown-gray, less than 40% sand, less than 10% silt and clay, 2½" gravel.
430	Gravel with Sand, Silt & Clay: Poorly sorted, brown-black, subangular, 3/4" gravel, less than 20% sand, less than 10% silt and clay.
440	Gravel with Sand, Silt & Clay: Poorly sorted, blue-black, subangular, 3/4" gravel, less than 15% sand, less than 10% silt and clay.
450	Gravel with Sand, Silt & Clay: Poorly sorted, subangular, gray-black, ½" gravel, less than 40% sand, less than 10% silt and clay.
460	Gravel with Sand, Silt, & Clay: Poorly sorted, subangular, gray-brown, ½" gravel, less than 40% sand, 10% silt and clay.
470	Gravel with Sand, Silt and Clay: Brown-gray poorly sorted subrounded, max 2" gravel, less than 20% sand, less than 10% silt and clay.
480	Gravel with Sand and Clay: Gray-black colored, poorly sorted subangular gravel with less than 30% coarse to fine-grained sand with less than 10% silty clay. Max grain size 3/4".
490	Gravel with Sand: White, gray-black colored moderately sorted subangular gravel with less than 20% coarse subangular sand grains. Maximum grain size 1".
500	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac
EQUIPMENT USED Reverse Circulation	LOGGED BY JM & SC DATE 1-14-80
COMPANY Beylik	CHECKED BY JAG DATE 4-10-80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	Gravel with Sand: Gray, black colored moderately sorted subrounded to subangular gravel with less than 15% coarse subangular sand. Maximum gravel size approximately 2"
510	Gravel with Trace Coarse Sand: Brown, subangular, well sorted, gravel to 1½", less than 10% sand.
520	Gravel with Trace Sand and Silt: Same as 510' with less than 10% sand and silt.
530	Gravel with Trace Coarse Sand: Same as 510'.
540	
550	Gravel with Sand and Silt: Brown-gray, subangular, moderate sorting. Less than 25% sand and silt.
560	Gravel with Trace Coarse Sand: Same as 510'.
570	
580	
590	
600	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW-2

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T3S, R64E, Sect. 12ac
EQUIPMENT USED Reverse Mud Rotary	LOGGED BY SC & JM DATE 1/15/80
COMPANY Beylik	CHECKED BY JAG DATE 4/10/80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	
610	Gravel with Trace Coarse Sand: Brown, subangular, well sorted, gravel to 1½", less than 10% sand.
620	
630	Gravel with Trace Coarse Sand: Same as 610', but max size ½".
640	Gravel with Sand and Silt: Brown, subangular, poorly sorted, less than 30% sand, less than 10% silt, gravel size to ½".
650	
660	
670	
680	
690	
700	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T3S, R64E, Sect. 12 ~~ca~~ a
EQUIPMENT USED Reverse Mud Rotary	LOGGED BY SC DATE 1/17/80
COMPANY Beylik	CHECKED BY JAG DATE 4/10/80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	Gravel with Some Coarse Sand: Brown, subangular, well sorted gravel size to 3/4", less than 20% sand.
710	Gravel with Some Coarse Sand: Same as 700' but with gravel to 2".
720	Gravel with Some Coarse Sand: Same as 700'.
730	Gravel with Sand, Silt, & Clay: Brown, subangular gravel to ½" size with 20% sand, 20% silt & clay.
740	Gravel with Some Coarse Sand: Same as 700'.
750	Gravel with Trace Coarse Sand: Same as 700' but less than 10% sand, & gravel to 3".
760	Gravel with Trace Coarse Sand: Same as 750'.
770	Gravel with Some Coarse Sand: Same as 700'.
780	
790	
800	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac
LOGGED BY SC & JM DATE 1-18-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	Coarse Sand Trace Gravel & Silt: Brown subangular, well sorted, coarse sand, less than 10% gravel, less than 10% silt.
810	Gravel with Some Coarse Sand: Brown, subangular, well sorted, gravel size to 1", 20% sand.
820	
830	
840	
850	
860	
870	
880	
890	
900	

FUGRO NATIONAL, INC.

DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T3S, R64E, Sect. 12 22

LOGGED BY JM & SC DATE 1-19-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	Sand with Some Gravel & Silt: Brown subangular, poorly sorted, sand with 10% silt & clay, 20% gravel.
910	
920	
930	
940	Gravel with Trace Coarse Sand: Brown subangular, well sorted, gravel to 3/4", 10% sand.
950	
960	
970	
980	
990	
1000	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12 ~~cc~~ cc
LOGGED BY JM & SC DATE 1-20-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	
1010	Gravel with Cobbles: Dark colored, poorly sorted subangular to angular (predominantly angular) gravel with less than 5% broken cobbles up to 3".
1020	Gravel with Cobbles: As above (1010'), more darker rocks, medium to dark color.
1030	Gravel with Sand: Medium color, poorly sorted, subangular to angular gravel up to 1", with less than 20% fine-to coarse-grained, angular to subangular sand.
1040	Gravel: Medium color, poorly sorted, subangular to angular gravel with 20% cobbles up to 2½", with 20% medium to coarse, subangular to angular sand.
1050	Gravel: Light to dark colored, poorly sorted, subrounded to angular gravel up to 1½".
1060	Gravel with Sand: Light to dark color, medium sorted, subangular to angular gravel up to 3/4".
1070	Gravel: Medium to dark color, well sorted, angular to subangular fine-grained gravel up to ¼".
1080	Gravel with Sand: Medium to dark color, poorly sorted, subangular to angular gravel up to 1" with less than 25% coarse-to medium-grained, subangular to angular sand.
90	
[illegible]	Gravel: as above (1080'), but medium sorted.

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake Valley
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T3S, R64E, Sect. 12 ~~ac~~ ac
EQUIPMENT USED Reverse Rotary	LOGGED BY JM & LB DATE 1-21-80
COMPANY Beylik	CHECKED BY JAG DATE 4-10-80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1100	
1110	Gravel: Dark colored, well sorted, angular gravel up to 3/8".
1120	Gravel: Medium color, poorly sorted, subrounded to angular gravel up to ½" with less than 20% sand.
1130	Gravel with Sand: Light to dark color, poorly sorted, subrounded to rounded gravel up to 1" with 20% coarse to fine sand.
1140	Gravel with Sand: As above (1130') with occassional broken cobbles up to 4".
1150	Gravel with Sand: Medium to dark color, medium sorted subangular to angular gravel up to 1" with less than 20% medium to coarse sand.
1160	Gravel with Sand: Light to dark color, well sorted angular to subangular,fine gravel with 20% coarse sand.
1170	Gravel: Medium color, poorly sorted, subangular to angular, fine to 1½" gravel.
1180	
1190	Gravel: Dark colored, poorly sorted, angular to subangular fine up to 2" gravel.
1200	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER OW2

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T3S, R64E, Sect. 12~~ca~~ ac
LOGGED BY JM & LB DATE 1-22-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1300 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1200	
1210	Gravel: Medium to dark color, poorly sorted angular to subangular, fine up to 1½" gravel.
1220	Gravel: Medium to dark color, medium sorted, subrounded to subangular, fine to ½" gravel.
1230	
1240	Sand with Gravel: Light to medium color, medium sorted, subrounded to subangular, medium to coarse sand with less than 10% gravel up to ½".
1250	Sand and Gravel: Light to dark color, well sorted, angular to subangular, fine gravel with 50% coarse sand.
1260	Gravel with Sand: Light to medium colored medium sorted, subangular to angular gravel with less than 25% coarse sand.
1270	Gravel: Light to dark colored, well sorted, angular to subangular gravel up to 3/8".
1280	Sand & Gravel: Light to dark colored, well sorted, angular to subangular, fine gravel with ± 50% coarse sand.
1290	Gravel with Sand: Medium to dark colored, poorly sorted, angular to subangular gravel up to 3/4" with ± 25% coarse sand.
1300	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

4

T Well

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Bucket Auger 0'-40' Reverse Rotary 40' - TD

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12

LOGGED BY JM DATE 2-6-80

CHECKED BY JAG DATE 4/10/80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
0	Silt: Tan silt with occasional gravel up to 1½".
10	Silt: Tan silt.
20	Silt: Tan silt with less than 25% medium colored, fine- to coarse-grained, poorly sorted, subrounded to subangular sand with less than 10% gravel up to 1½".
30	Gravel with Cobbles: Medium to dark colored, subrounded to subangular, medium gravel with cobbles up to 4".
40	Gravel: Medium colored, moderately sorted, angular to subrounded, fine to coarse gravel up to 1½".
50	- - - Gravel up to 1".
60	Gravel: Medium colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1½" with less than 5% coarse-grained sand.
70	- - - Gravel up to 3/4".
80	
90	- - - Gravel up to 1½".
100	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sect. 12
LOGGED BY JFM DATE 2-6-80
CHECKED BY JAG DATE 4/1_/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
100	Gravel: Dark brown colored, well sorted, subangular to subrounded, gravel up to ½".
110	- - - - Very well sorted gravel up to ¼".
120	- - - - Gravel up to 3/4".
130	Gravel: Light to dark colored, very well sorted, subangular to subrounded gravel up to ½".
140	Gravel: Light to dark colored, poorly sorted, subangular to subrounded gravel with occasional cobbles up to 2". Less than 20% medium- to coarse-grained sand.
150	Gravel: Light to dark colored, well sorted, subangular to subrounded, fine to medium gravel, occasionally up to 1", with less than 10% coarse-grained sand.
160	Gravel with Cobbles: Light to dark colored, poorly sorted, angular to subrounded, fine to coarse gravel, with cobbles up to 3" and less than 5% coarse-grained sand.
170	
180	Gravel: Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel, with occasional cobbles up to 1½" and less than 5% coarse sand.
190	- - - - Cobbles up to 2".
200	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12d

LOGGED BY JFM DATE 2-06-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
200	Gravel: Light to dark colored, poorly sorted, angular to subangular, fine to coarse gravel with less than 20% cobbles up to 2½" and less than 5% coarse-grained sand.
210	Gravel: Light to dark colored, moderately sorted, angular to subangular, fine to coarse gravel, with occasional cobbles up to 4" and less than 5% medium- to coarse-grained sand.
220	Gravel: Light to dark colored, well sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% medium- to coarse-grained sand.
230	Gravel: Light to dark colored, moderately sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 10% medium- to coarse-grained sand.
240	- - - - Gravel up to 2".
250	
260	Sand: Medium colored, well sorted, fine-grained sand, with less than 25% medium-grained sand to coarse gravel up to 2".
270	Gravel: Medium to dark colored, medium sorted, subangular to subrounded, fine to coarse gravel up to 2½", with less than 10% coarse-grained sand.
280	Gravel with Sand: Medium to dark colored, poorly sorted, subrounded to angular, fine to coarse gravel up to 1½", and approximately 25% medium colored, fine- to coarse-grained sand.
290	Gravel: Medium to dark colored, moderately sorted, subrounded to subangular, fine to medium gravel up to ½", with approximately 10% fine- to coarse-grained sand.
300	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45	VALLEY NAME Dry Lake
PROJECT NAME MX SITING INVESTIGATION	LOCATION NUMBER T6S, R63E, Sec. 12d-/C
EQUIPMENT USED Reverse Rotary	LOGGED BY LB DATE 2-07-80
COMPANY Beylik	CHECKED BY JAG DATE 4-10-80
OPERATOR J. Clyde	TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
300	Gravel: Medium to dark colored, moderately sorted, subrounded to angular, fine to medium gravel up to 1/3", with approximately 10% fine- to coarse-grained sand.
310	Gravel: Medium to dark colored, poorly sorted, subangular to angular, fine to 2½" gravel.
320	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 2" gravel (less than 10% sand).
330	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 2½" gravel (less than 5% sand).
340	Gravel with Sand: Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 20% medium colored, medium-to coarse-grained sand.
350	Gravel: Dark colored, poorly sorted, subangular to angular, fine to 3/4" gravel with less than 10% sand.
360	Gravel: Dark colored, moderately sorted, subangular to angular, fine to ½" gravel.
370	Gravel: Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 1" gravel.
380	Gravel: Dark colored, poorly sorted, subangular, fine to ½" gravel (with less than 10% sand).
390	Gravel: Medium to dark colored, poorly sorted, subangular to angular, 1/3"-diameter gravel with less than 15% sand.
400	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY LB , JM DATE 2-07-80
CHECKED BY JAG DATE 4-10-80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
400	Gravel: Light to dark color, medium sorted, subangular to subrounded gravel up to ½" with less than 15% medium- to coarse-grained sand.
410	Gravel with Sand & Clay: Medium colored, poorly sorted, subangular to subrounded gravel up to 3/8", with less than 50% fine- to coarse-grained sand and clay.
420	
430	Gravel: Medium to dark colored, well sorted, subangular to subrounded gravel up to ½", with less than 20% coarse-grained sand.
440	- - - Gravel up to 1".
450	- - - Less than 10% coarse sand.
460	Gravel with Sand: Light to dark colored, poorly sorted, subangular to subrounded, fine to coarse gravel up to 1", with less than 30% fine to coarse-grained sand.
470	Gravel with Sand: Medium to dark colored, poorly sorted, subrounded to subangular, fine to 1" gravel with less than 25% medium- to coarse-grained sand.
480	
490	- - - Gravel up to 3/4".
500	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY LB, JFM DATE 2/08/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
500	Gravel with Sandy Silt: Medium to dark colored, poorly sorted, subrounded to angular, fine to 1" gravel with less than 30% tan colored, coarse-grained sand to silt.
510	Gravel: Medium to dark colored, moderately sorted, angular, fine to 1½" gravel.
520	- - - 5% fine- to coarse-grained sand.
530	
540	Gravel: Light to dark colored, poorly sorted, angular to subangular, fine to 2¼" gravel with less than 10% sand.
550	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 25% medium colored, fine- to coarse-grained sand.
560	Gravel and Sand: Medium to dark colored, poorly sorted, angular to subangular, fine to ½" gravel with less than 40% medium to dark colored sand.
570	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to 1" gravel with less than 20% fine- to coarse-grained sand.
580	Gravel: Dark colored, moderately sorted, subrounded to subangular gravel with less than 10% sand.
590	- - - Sand content up to about 25%.
600	

FUGRO NATIONAL, INC.

DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12ac

LOGGED BY LB DATE 2-08-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
600	Sand and Gravel with Silt: Dark colored, moderately sorted, fine-grained to ½" sand and gravel with less than 50% tan silt.
610	Gravel: Dark colored, moderately sorted, subangular to angular, fine to 1" gravel.
620	Gravel: Dark colored, moderately sorted, subrounded to subangular, fine to 2" gravel with less than 10% sand.
630	Gravel: Dark colored, moderately sorted, subangular to angular, fine to 1" gravel with less than 5% coarse-grained sand.
640	Gravel: Dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 2" gravel.
650	Gravel: Medium to dark colored, well sorted, subangular to angular, fine to 1/3" gravel.
660	Gravel: Medium to dark colored, poorly sorted, subangular to angular (predominantly angular), fine to 1½" gravel, with less than 10% sand.
670	Gravel: Medium to dark colored, moderately sorted, subangular to angular, fine to 1/3" gravel.
680	- - - *Increasing fine-grained gravel.*
690	Gravel: Medium to dark colored, well sorted, subrounded to angular, fine to ½" gravel.
700	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY LB, JFM DATE 2/09/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
700	
710	Gravel: Dark colored, well sorted, subangular to angular, fine to 1½" gravel.
720	Gravel: Dark colored,well sorted,subangular to angular (predominantly angular), fine to 1" gravel.
730	Gravel: Dark colored, poorly sorted, subangular, fine to medium gravel up to ½" with less than 25% fine- to coarse-grained sand.
740	Gravel: Dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 1" with less than 10% fine- to coarse-grained sand.
750	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel, occasionally up to 1½", with less than 10% fine- to coarse-grained sand.
760	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 3/4" (predominantly fine gravel), with less than 10% medium- to coarse-grained sand.
770	Gravel with Sand: Medium to dark colored, poorly sorted, angular to subangular, fine to medium gravel up to 3/4" with less than 35% fine- to coarse-grained sand.
780	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to ½" with less than 10% medium- to coarse-grained sand.
790	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" (predominantly 1/8" to 1/4").
800	

TERRA NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290- 45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12

LOGGED BY JFM DATE 2-10-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
800	Gravel: Light to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1".
810	Gravel: Medium to dark color, poorly sorted, angular to subangular, fine to medium gravel (predominantly less than ¼" and up to 3/4"), with less than 10% coarse-grained sand.
820	Gravel: Medium to dark color, well sorted, angular to subangular, fine to medium gravel (predominantly fine, occasionally up to ½"), with less than 10% coarse-grained sand.
830	Gravel: Dark colored, moderately sorted, angular to subangular, fine to medium with occasional coarse gravel up to 2-3/4", with less than 5% coarse-grained sand.
840	Gravel: Medium to dark colored, poorly sorted, angular to subangular, fine to medium, occasionally up to 1".
850	
860	- - - - Gravel up to 1¼", with less than 5% coarse sand.
870	Gravel: Medium to dark colored, moderately sorted, angular to subangular, fine to medium gravel up to 1" with less than 5% coarse-grained sand.
880	Gravel: Medium to dark colored, moderately sorted, angular, fine to medium gravel up to 1¼".
890	Gravel: Medium to dark colored, moderately to well sorted, angular to subangular, fine to medium gravel up to 3/4".
900	

FUGRO NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290-45
PROJECT NAME MX SITING INVESTIGATION
EQUIPMENT USED Reverse Rotary
COMPANY Beylik
OPERATOR J. Clyde

VALLEY NAME Dry Lake (DL)
LOCATION NUMBER T6S, R63E, Sec. 12
LOGGED BY JFM, LB DATE 2/10/80
CHECKED BY JAG DATE 4/10/80
TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
900	Gravel: Medium to dark colored, well sorted, angular to subangular, fine gravel up to ¼", with less than 5% coarse-grained sand.
910	Gravel: Medium to dark colored, well sorted, angular to subangular, fine to medium gravel, occasionally up to 1", with less than 5% coarse-grained sand.
920	Gravel: Medium to dark colored, moderately well sorted, angular to subangular, fine to medium gravel up to 3/8", with less than 5% coarse-grained sand.
930	
940	Gravel and Sand: Dark colored, well sorted, subangular to angular, fine gravel and coarse-grained sand.
950	Gravel: Dark colored, poorly sorted, subangular to angular, fine to 2" gravel, with less than 10% medium- to coarse-grained sand.
960	
970	Gravel: Dark colored, well sorted, subrounded to subangular, fine to 1/3" gravel, with less than 20% fine- to coarse-grained sand.
980	Gravel: Dark colored, poorly sorted, subrounded to angular, fine to 3" gravel, with less than 10% sand.
990	Gravel: Dark colored, moderately well sorted, subangular to angular, fine to 1½" gravel, with less than 5% sand.
1000	

ERTEC NATIONAL, INC.
DRILL CUTTINGS LOG

FIELD LOG OF WELL NUMBER TW-1

PROJECT NUMBER 79-290-45

PROJECT NAME MX SITING INVESTIGATION

EQUIPMENT USED Reverse Rotary

COMPANY Beylik

OPERATOR J. Clyde

VALLEY NAME Dry Lake

LOCATION NUMBER T6S, R63E, Sec. 12 AC

LOGGED BY JFM, LB DATE 2-10-80

CHECKED BY JAG DATE 4-10-80

TOTAL WELL DEPTH 1010 feet

DEPTH (FEET)	DESCRIPTION OF CUTTINGS OR SAMPLE
1000	Gravel and Cobbles: Medium to dark colored, poorly sorted, subangular to angular gravel to 3". Broken cobbles to 6".
1010	
	T.D.: 1010'
20	
30	
40	
50	
60	
70	
80	
90	
00	

AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2

MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)

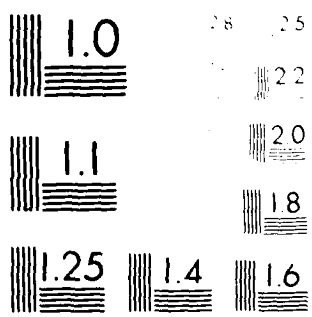
SEP 81 F04704-80-C-0006

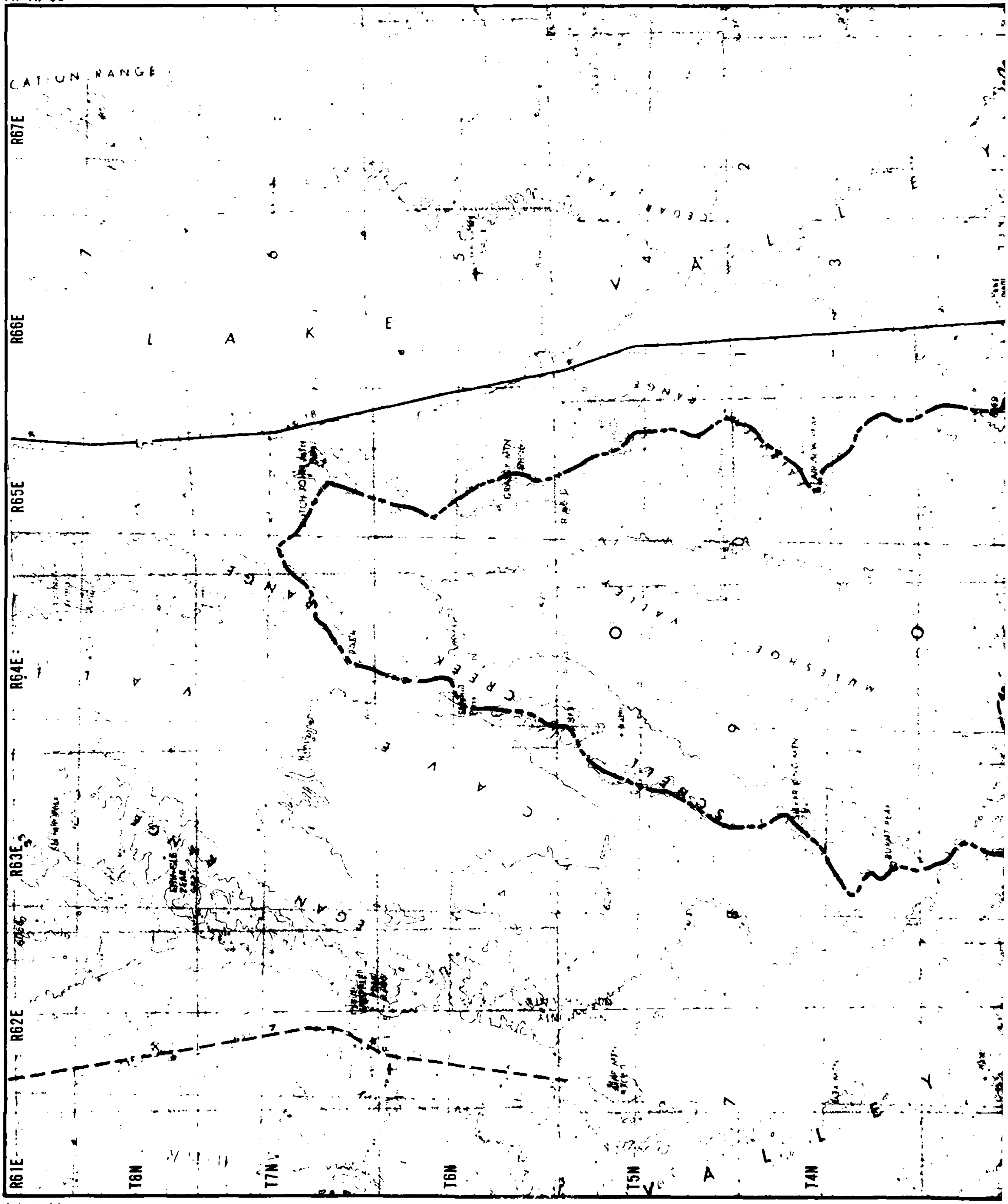
UNCLASSIFIED E-TR-53-2 NL

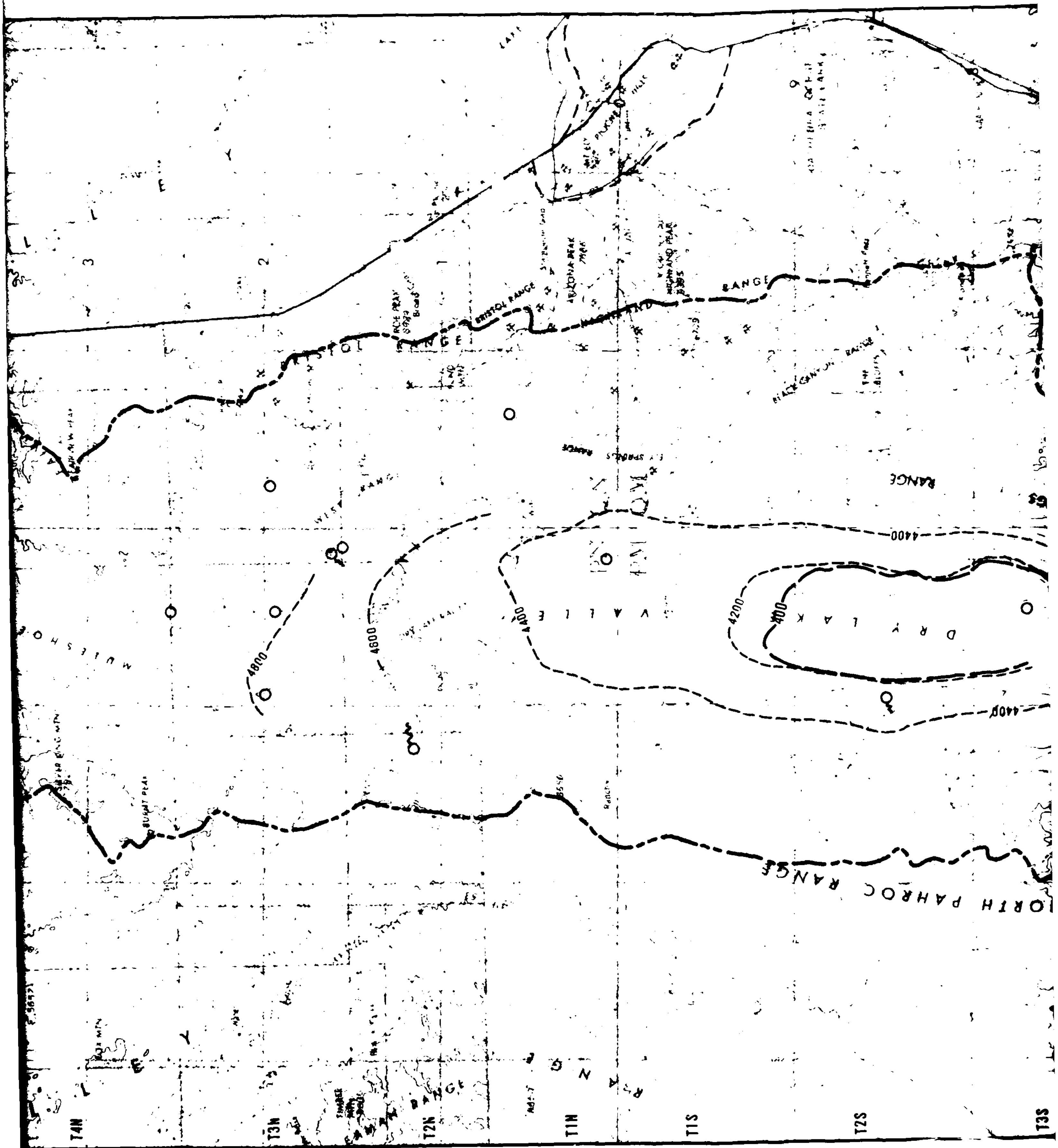
2 OF 3

AD A
112959

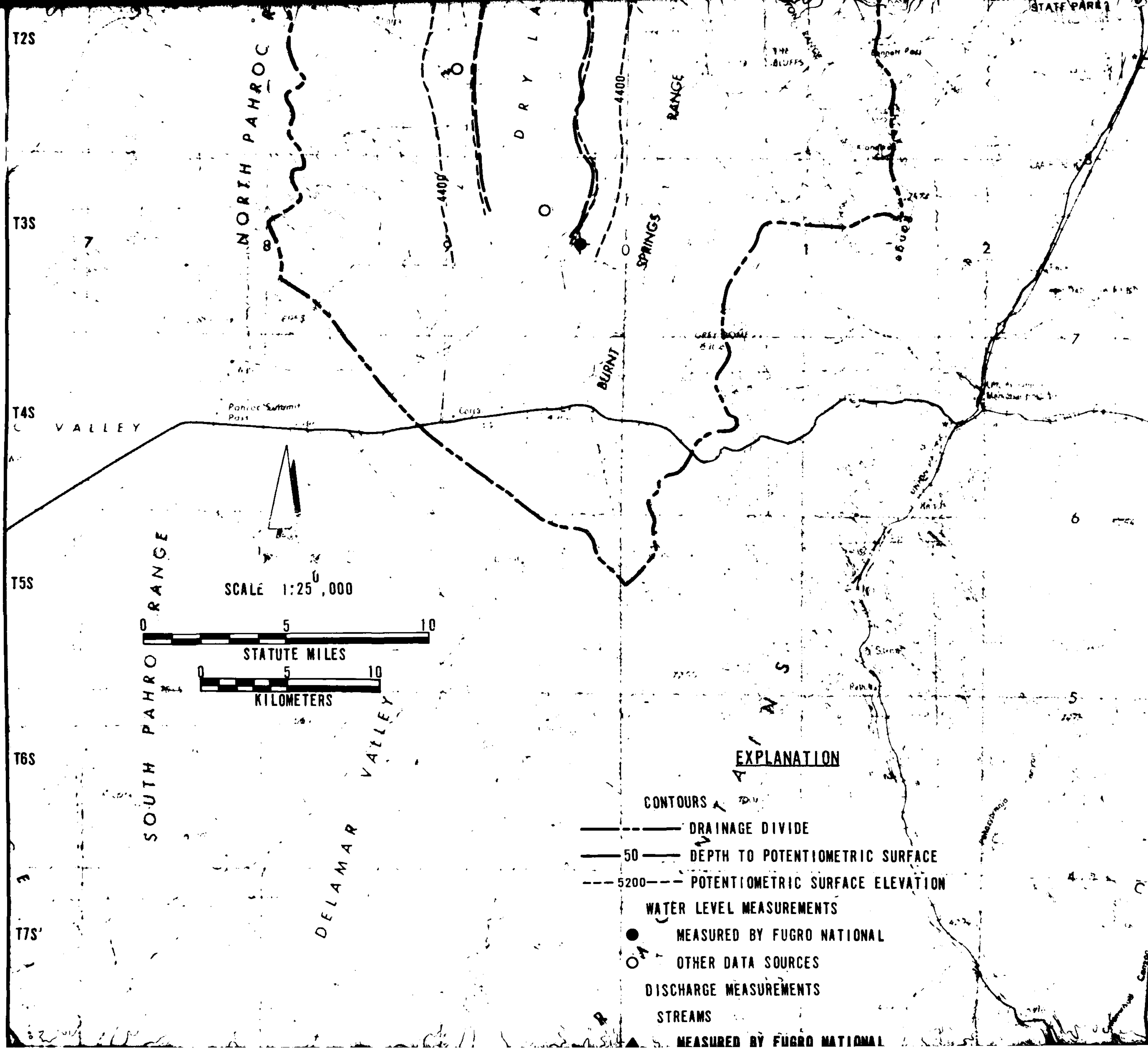
2959




CATION RANGE
R67E
R66E
R65E
R64E
R63E
R62E
R61E
T6N
T7N
T6N
T5N
T4N
L A K E
V A L L E Y

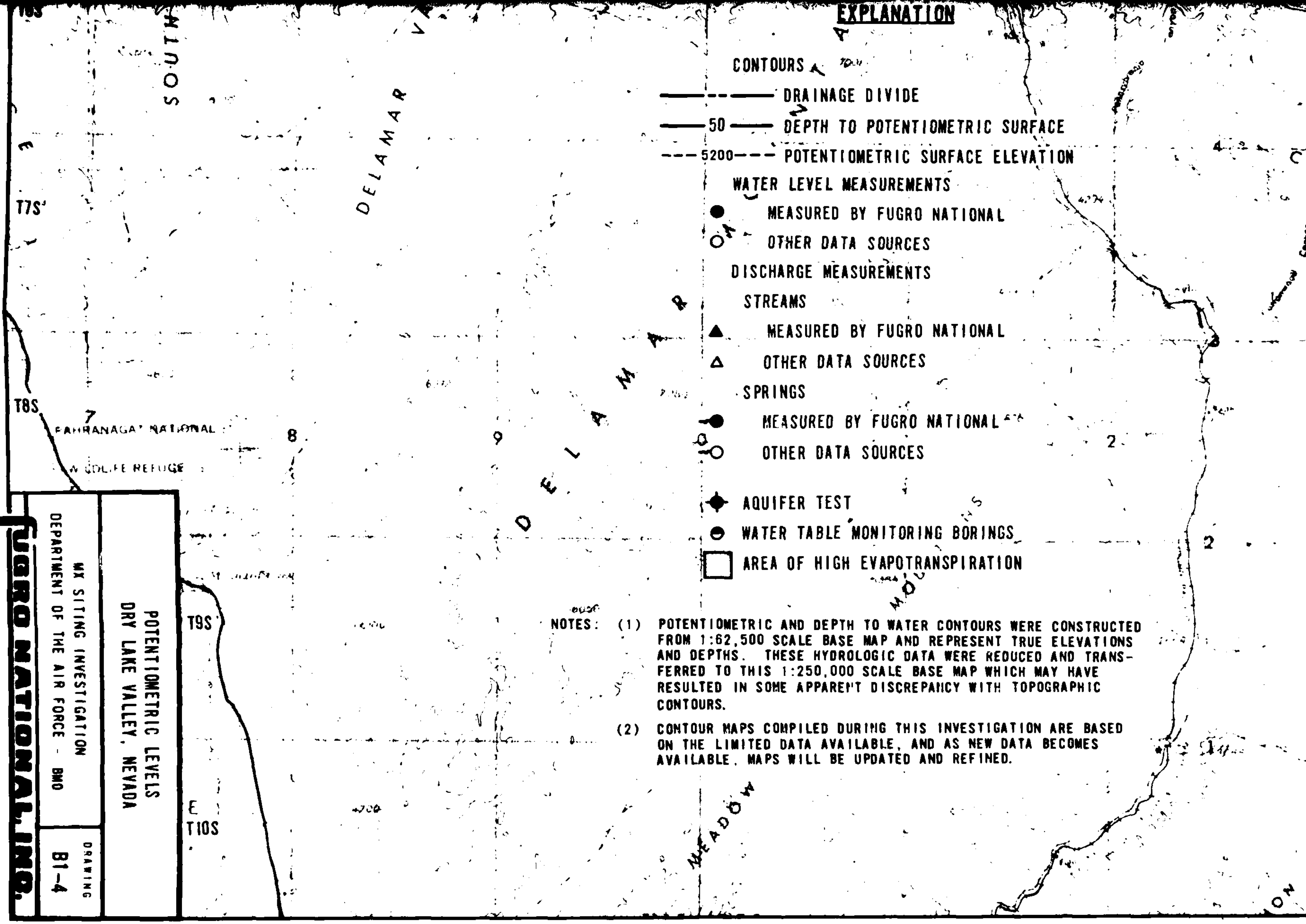

BRISTOL RANGE
DRY LAKE
VALLEY
NORTH PAHROC RANGE
4800
4600
4400
4200
T4N
T3N
T2N
T1N
T1S
T2S
T3S

12



STATE PARK
T2S
T3S
T4S
T5S
T6S
T7S
NORTH PAHROC
DRY LAKE
RANGE
BURNT SPRINGS
4400
VALLEY
SOUTH PAHROC RANGE
DELAMAR VALLEY
SCALE 1:250,000
0 5 10
STATUTE MILES
0 5 10
KILOMETERS
EXPLANATION
CONTOURS
DRAINAGE DIVIDE
50 DEPTH TO POTENTIOMETRIC SURFACE
5200 POTENTIOMETRIC SURFACE ELEVATION
WATER LEVEL MEASUREMENTS
MEASURED BY FUGRO NATIONAL
OTHER DATA SOURCES
DISCHARGE MEASUREMENTS
STREAMS
MEASURED BY FUGRO NATIONAL

E-3



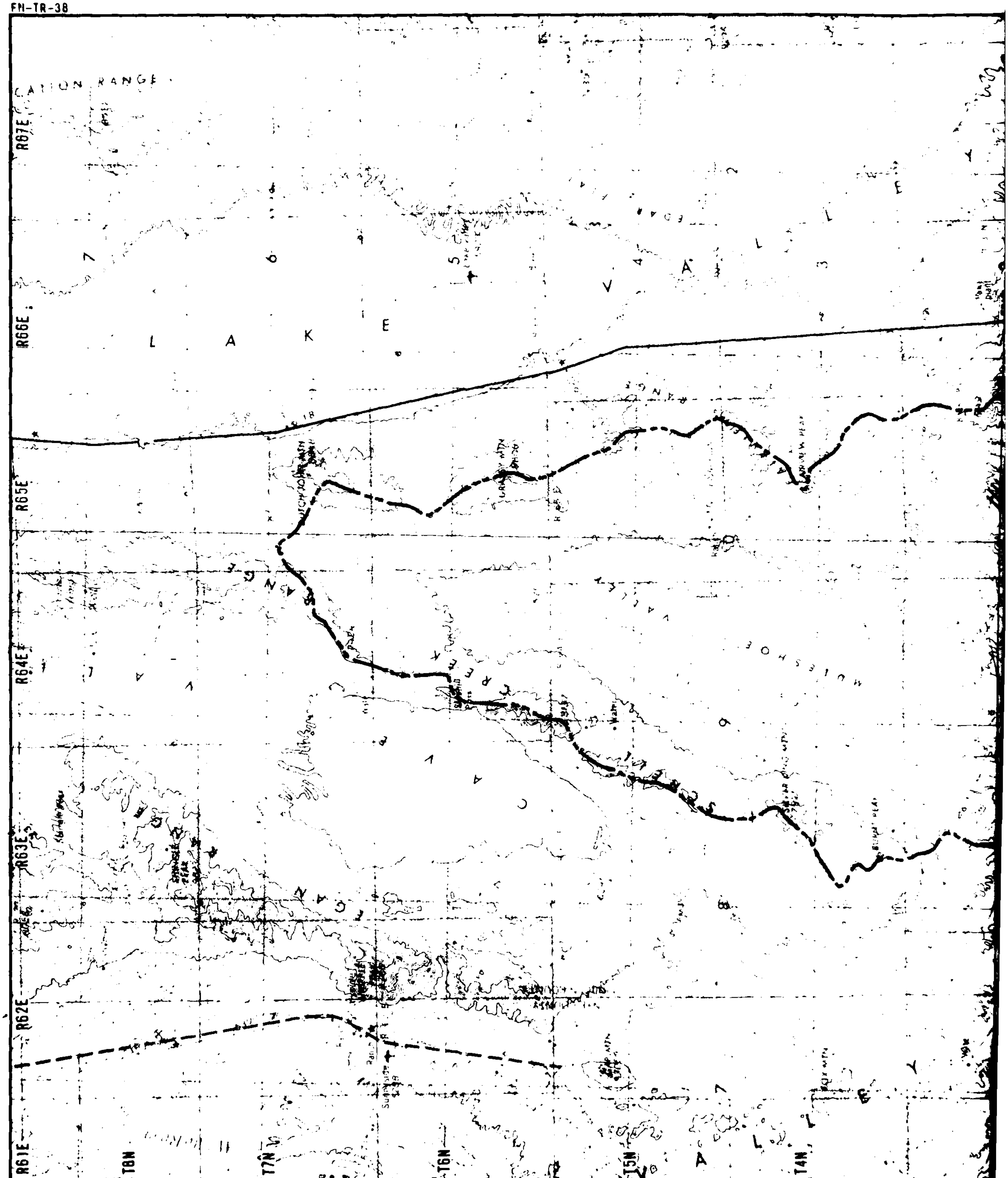
POTENTIOMETRIC LEVELS
DRY LAKE VALLEY, NEVADA

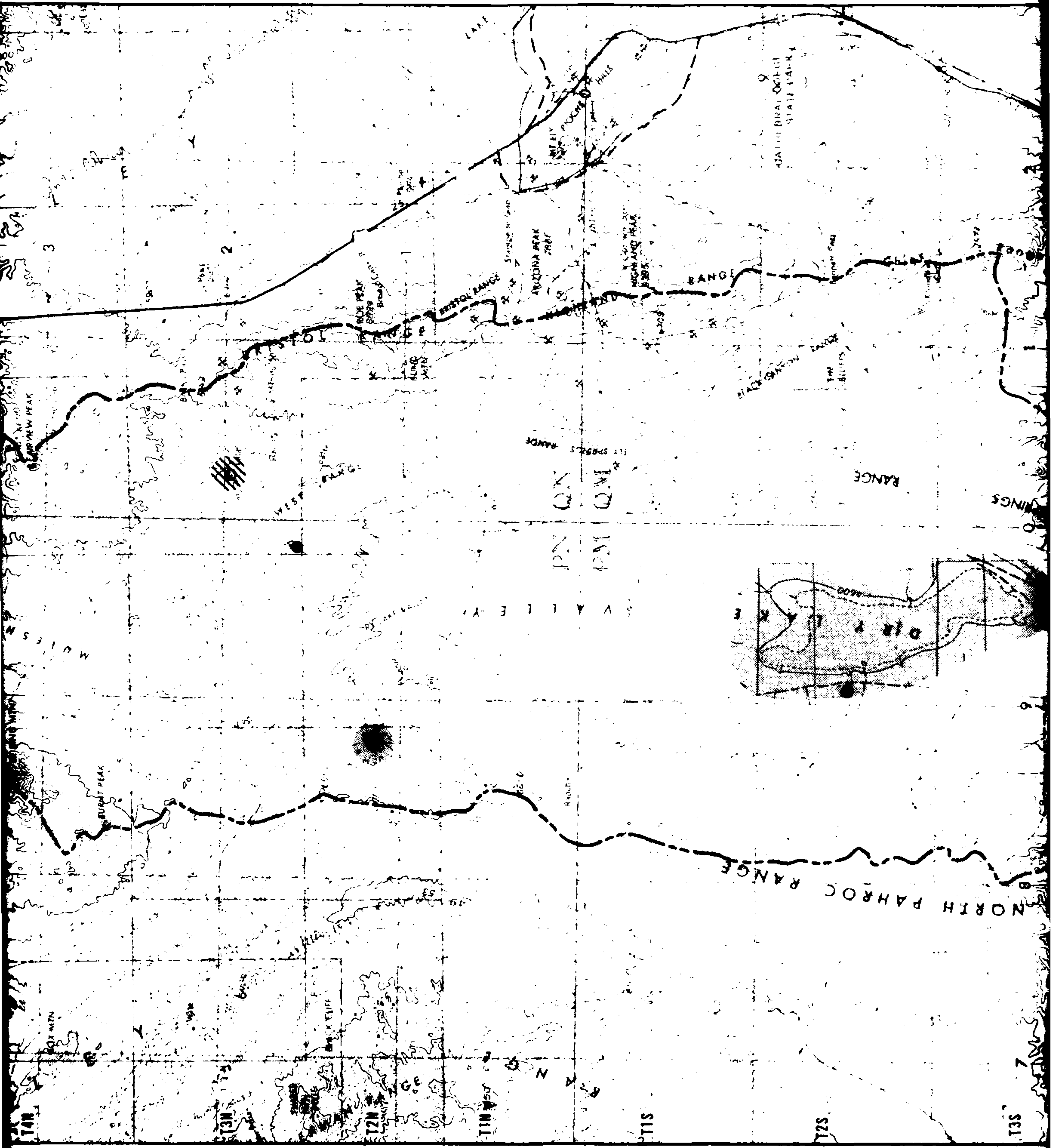
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

DRAWING
B1-4

FUGRO NATIONAL, INC.

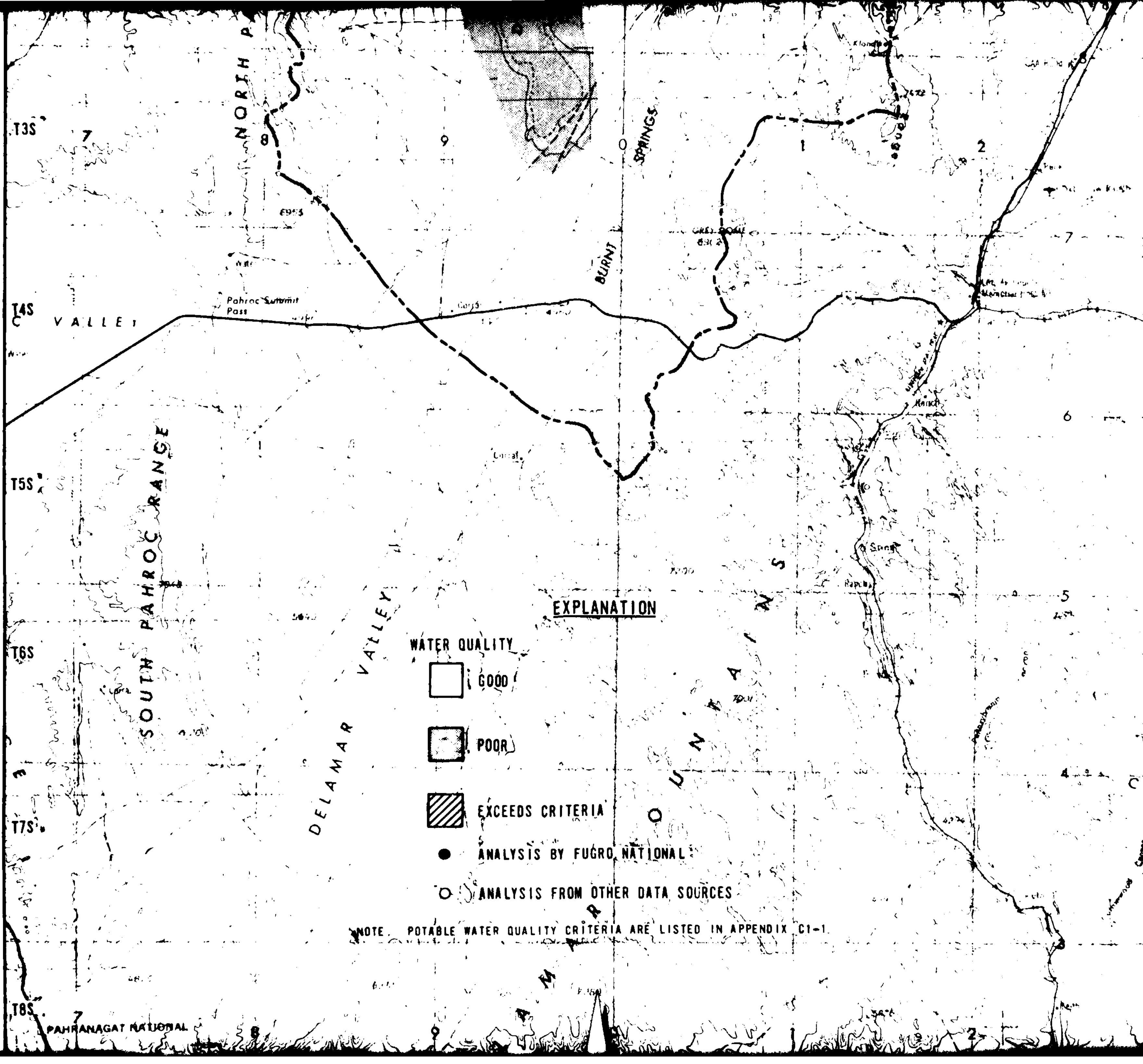
4

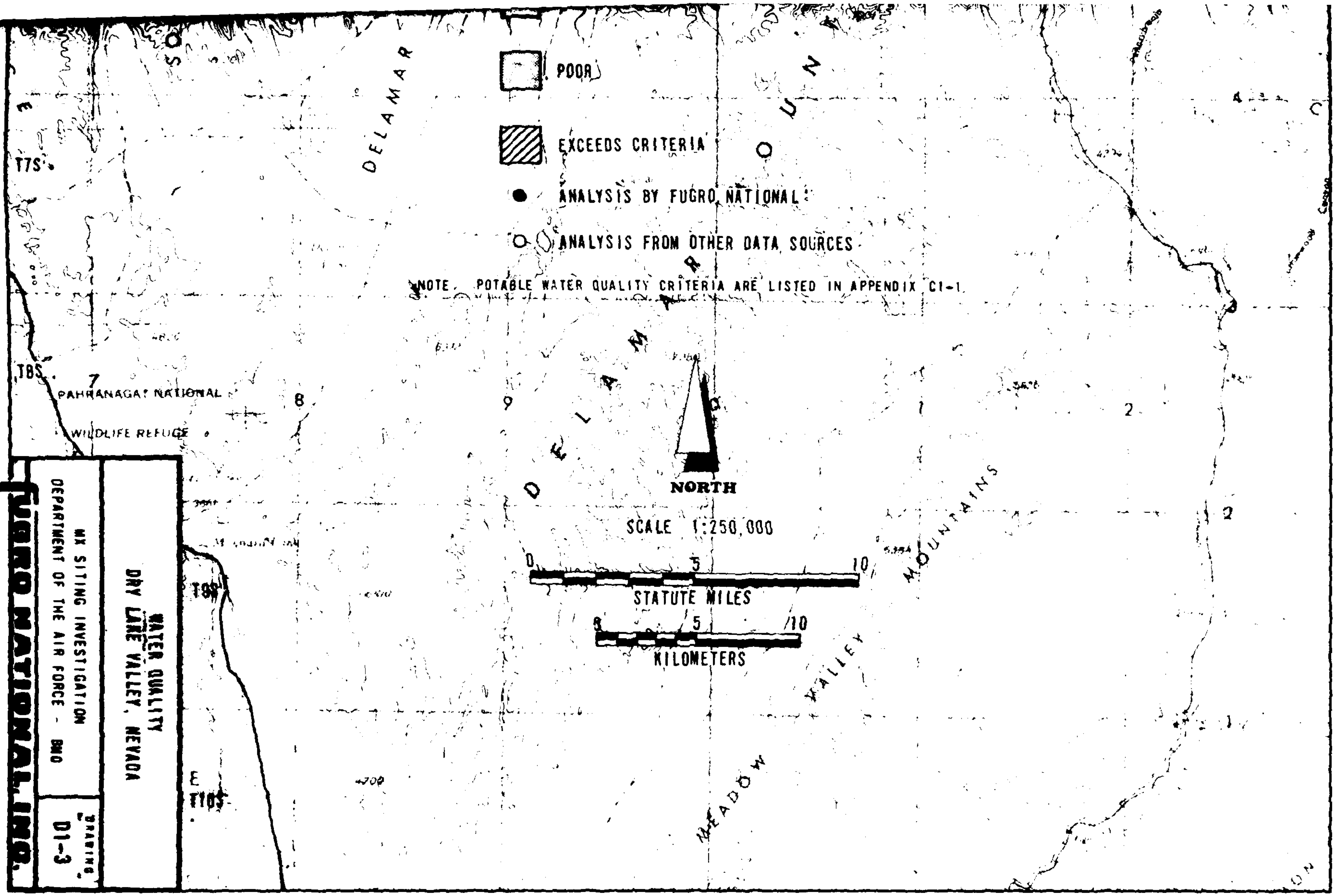

R67E
R66E
R65E
R64E
R63E
R62E
R61E
T8N
T7N
T6N
T5N
T4N
LAKE
VALLEY


BRISTOL RANGE
HIGHLAND PEAK
ARIZONA PEAK
CATHEDRAL GORGE STATE PARK
BLACK CANYON RANGE
FAIRVIEW PEAK
WEST RANGE
RANGE
VALLEY
DRY LAKE
BURNT PEAK
NORTH PAHROC RANGE
BLACK CLIFF
T4N
T3N
T2N
T1N
T1S
T2S
T3S

1 2 1

13


EXPLANATION
WATER QUALITY
GOOD
POOR
EXCEEDS CRITERIA
ANALYSIS BY FUGRO NATIONAL
ANALYSIS FROM OTHER DATA SOURCES
NOTE. POTABLE WATER QUALITY CRITERIA ARE LISTED IN APPENDIX C1-1.
NORTH P
SOUTH PAHROC RANGE
DELAMAR VALLEY
BURNT SPRINGS
VALLEY
Pahroc Summit Pass
T3S
T4S
T5S
T6S
T7S
T8S
PAHRANAGAT NATIONAL
Corral
Ranch
Klondike


POOR
EXCEEDS CRITERIA
ANALYSIS BY FUGRO NATIONAL
ANALYSIS FROM OTHER DATA SOURCES
NOTE. POTABLE WATER QUALITY CRITERIA ARE LISTED IN APPENDIX C1-1.
NORTH
SCALE 1:250,000
STATUTE MILES
KILOMETERS
DELAMAR
DELAMAR MOUNTAINS
MEADOW VALLEY MOUNTAINS
PAHRANAGAT NATIONAL WILDLIFE REFUGE
T7S
T8S
T9S
T10S
WATER QUALITY
DRY LAKE VALLEY, NEVADA
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO
DRAWING
D1-3
FUGRO NATIONAL, INC.

4

F1.0

MX SITING INVESTIGATION, GRAVITY SURVEY-DRY LAKE VALLEY, NEVADA

FN-TR-33-DL

MX SITING INVESTIGATION

GRAVITY SURVEY - DRY LAKE VALLEY

NEVADA

Prepared for:

U.S. Department of the Air Force
Ballistic Missile Office (BMO)
Norton Air Force Base, California 92409

Prepared by:

Fugro National, Inc.
3777 Long Beach Boulevard
Long Beach, California 90807

17 March 1980

FOREWORD

Methodology and Characterization Studies during fiscal years 1977 and 1978 included gravity surveys in ten valleys in Arizona (five), Nevada (two), New Mexico (two), and California (one). The gravity data were obtained for the purpose of estimating the gross structure and shape of the basins and the thickness of the valley fill. There was also the possibility of detecting shallow rock in areas between boring locations. Generalized interpretations from these surveys were included in Fugro National's Characterization Reports (FN-TR-26a through e).

During the FY 77 surveys, the measurements were made to form an approximate one-mile grid over the study areas, and contour maps showing interpreted depth to bedrock were made. In FY 79, the decision was made to concentrate the available funds on the basic Verification Program to verify and refine suitable area boundaries. This decision resulted in a reduction in the gravity program. Instead of obtaining gravity data on a grid, the reduced program consisted of obtaining gravity measurements along profiles across the valleys where Verification Studies were also performed.

The Defense Mapping Agency (DMA), St. Louis, was also requested to provide gravity data from their library to supplement the gravity profiles. For Big Smoky, Reveille, and Railroad valleys, a sufficient density of library data is available to permit construction of interpreted contour maps instead of two-dimensional cross sections.

In late summer of FY 79, supplementary funds became available to begin data reduction. At this time, inner zone terrain corrections began on the library data and the profiles from Big Smoky Valley, Nevada, and Butler and La Posa valleys, Arizona. The profile data from Whirlwind, Hamlin, Snake East, White River and Garden Coal valleys, Nevada were available from the field in early October, 1979.

A continuation of gravity interpretations has been incorporated into the FY 80 contract and the results are being summarized in a series of valley reports. The reports covering Nevada-Utah gravity studies will be numbered, "FN-TR-33-", followed by the abbreviation for the subject valley. In addition, more detailed reports of the results of FY 77 surveys in Dry Lake and Ralston valleys, Nevada are being prepared. Verification Studies are continuing in FY 80 and gravity studies are included in the program. DMA will continue to obtain the field measurements and it is planned to return to the grid pattern. The interpretation of the grid data will allow the production of contour maps which will be valuable in the deep basin structural analysis needed for computer modeling in the Water Resources Program. The gravity interpretations will also be useful in the Nuclear Hardness and Survivability (NH&S) evaluations.

The basic decisions governing the gravity program are made by BMO following consultation with TRW Inc., Fugro National and the (DMA). Conduct of the gravity studies is a joint effort between DMA and Fugro National. The field work, including planning, logistics, surveying, and meter operation is done by the Defense Mapping Agency Hydrographic/Topographic Center (DMAHTC), headquartered in Cheyenne, Wyoming. DMAHTC reduces the data to Simple Bouguer Anomaly (see Section A1.4, Appendix A1.0). The Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, calculates outer zone terrain corrections.

Fugro National provides DMA with schedules showing the valleys with the highest priorities. Fugro National also recommended locations for the profiles in the FY 79 studies within the constraints that they should follow existing roads or trails. Any required inner zone terrain corrections are calculated by Fugro National prior to making geologic interpretations.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 OBJECTIVES

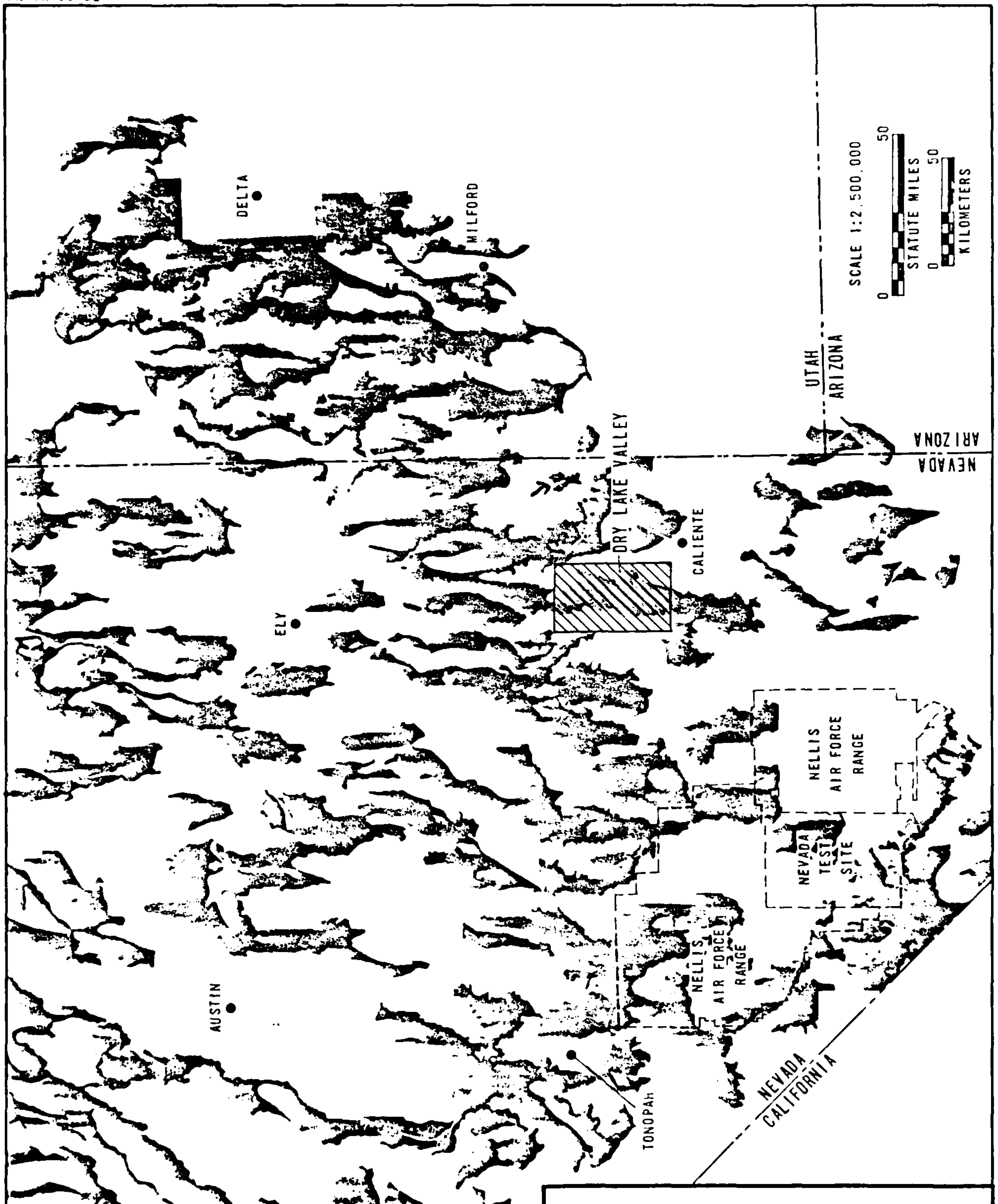
Measurements of the gravitational field were made in Dry Lake Valley for the purpose of estimating the overall shape of the structural basin and the thickness of alluvial fill in the basin. These estimates are expected to be useful to the Nuclear Survivability and Hardness (NH&S) community in modeling dynamic response to nuclear detonations and to geohydrologists in evaluating ground water regimes.

1.2 LOCATION

Dry Lake Valley is located in central Lincoln County, Nevada, approximately 106 miles (170 km) NNE of Las Vegas (see Figure 1). The portion of Dry Lake Valley included in this study is approximately 40 miles (65 km) long and 13 miles (22 km) wide, comprising an area of approximately 520 square miles (1347 km^2). As shown in Figure 2, Dry Lake Valley is bounded by mountain ranges on three sides and is open to Delamar Valley on the south. U.S. Highway 93, which is the only paved road in the vicinity, crosses the southern end of the valley.

1.3 SCOPE OF STUDY

The Defense Mapping Agency Hydrographic-Topographic Center/Geodetic Survey Squadron (DMAHTC/GSS) obtained gravitational field measurements at 1069 stations in and around Dry Lake Valley during June and July, 1977. Approximately one-half of these stations were distributed throughout the valley with about 1 mile (1.6 km) between stations. The rest of the stations were

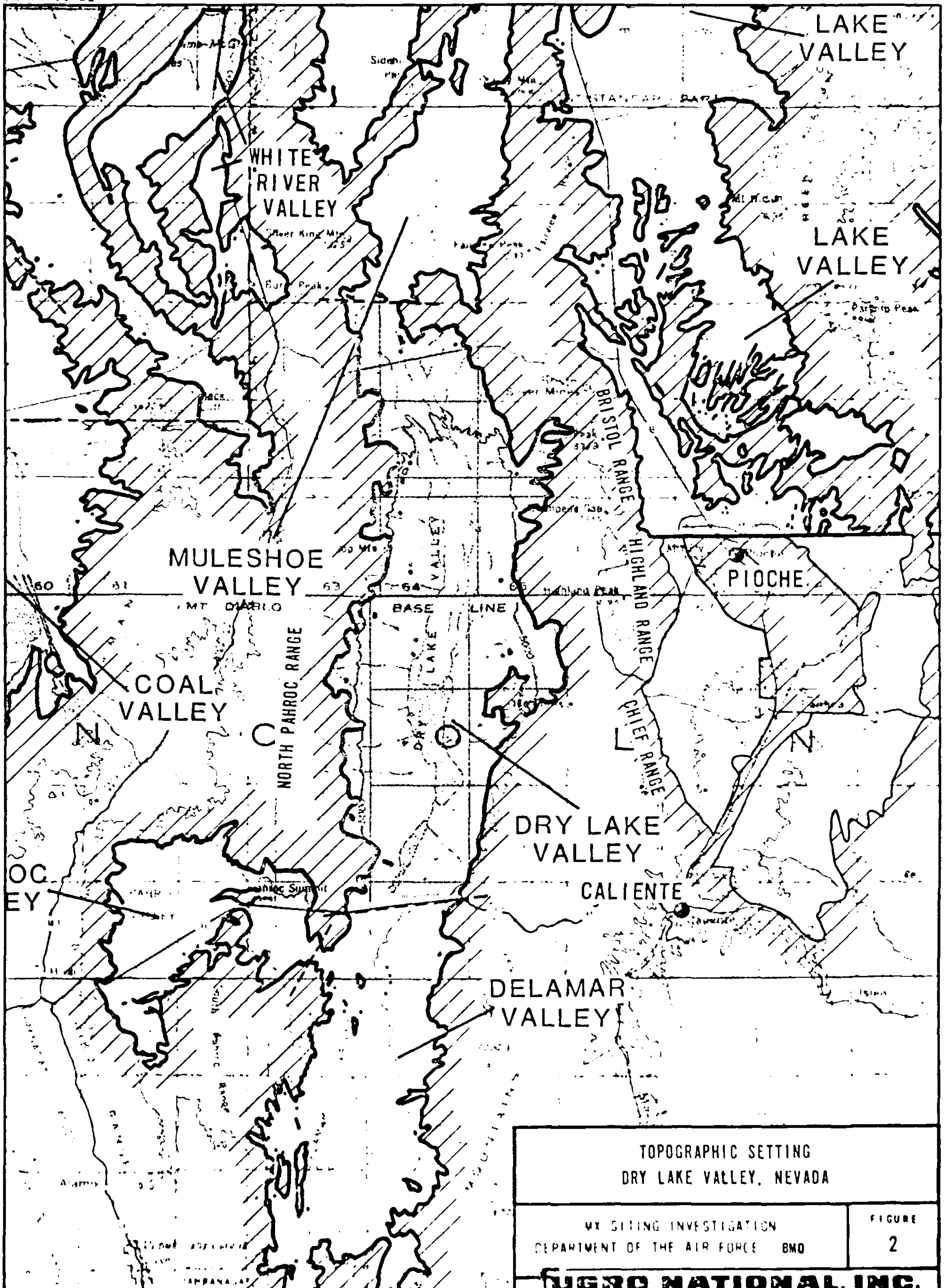


LOCATION MAP
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE - BMO	FIGURE 1

FUGRO NATIONAL, INC.

31 JAN 80



TOPOGRAPHIC SETTING
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 2

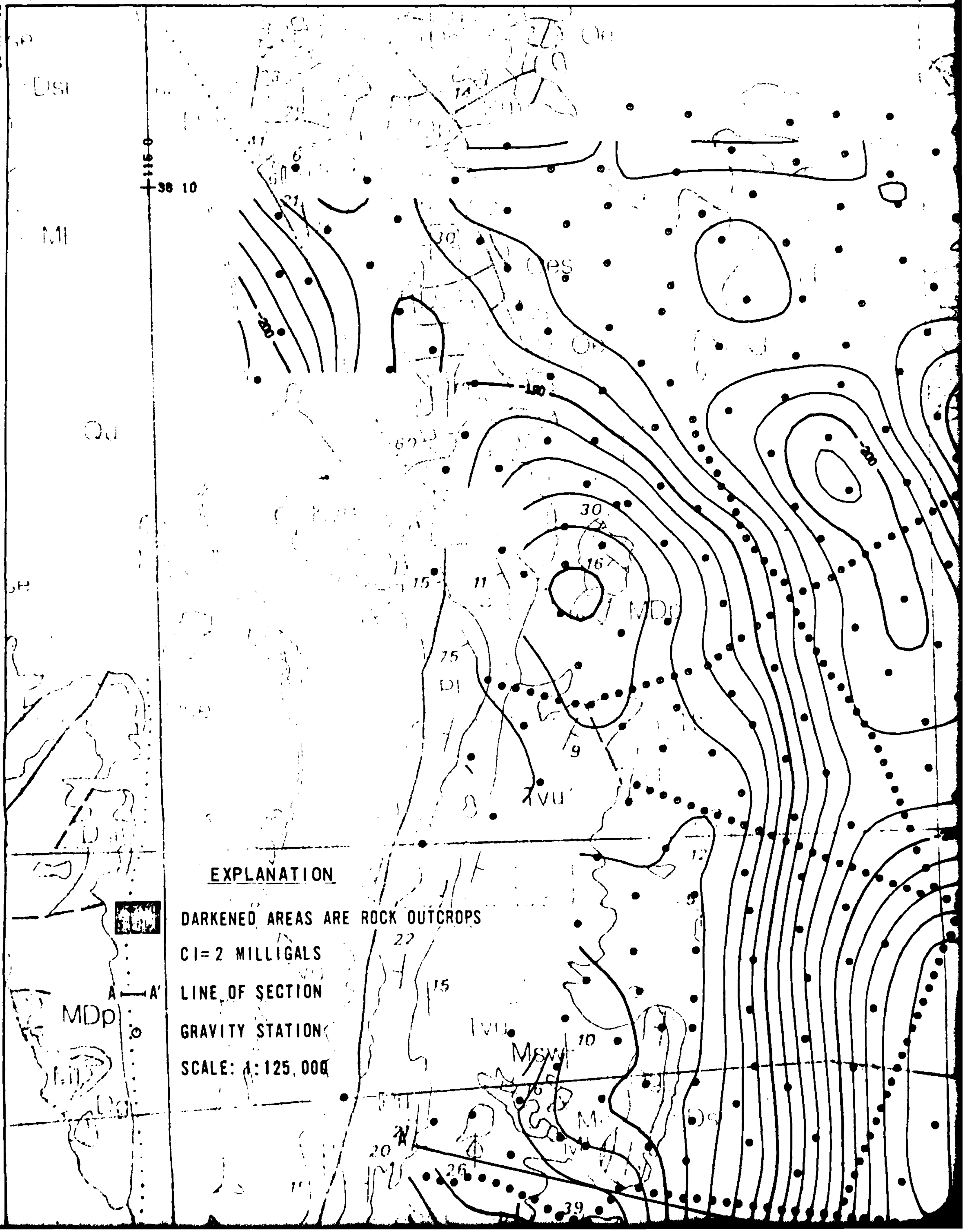
FUGRO NATIONAL, INC.

placed either at 1/4-mile (0.4 km) intervals along roads and trails or around the perimeter of the valley on rock outcrops. The station locations are shown on Figures 3 and 6. Station elevations were determined within a tolerance of 5 feet (1.5 m). With this elevation tolerance, the gravity precision is no smaller than 0.3 milligals. The principal facts for all stations are listed in Appendix A2.0.

In addition to the gravity data in Dry Lake Valley, information from two relatively long seismic refraction lines in the northern part of the valley was available. These seismic lines were recorded during Characterization studies by Fugro National in June, 1977 (FN-TR-26e).

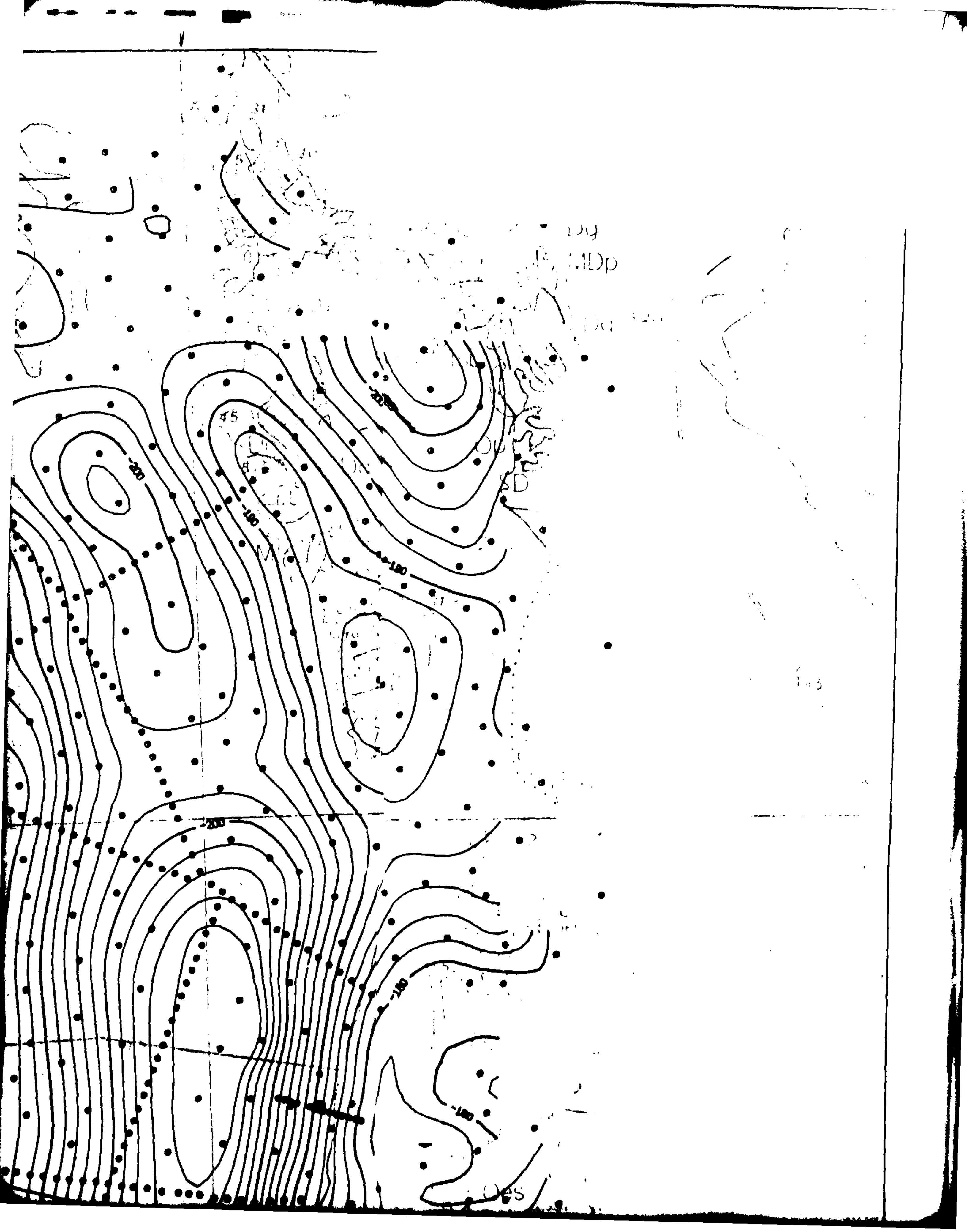
2.0 GRAVITY DATA REDUCTION

DMAHTC/GSS obtained the basic observations and reduced them to simple Bouguer Anomalies (SBA) for each station as described in Appendix A1.0. Up to three levels of terrain corrections were applied to convert the SBA to the complete Bouguer Anomaly (CBA). First, the Defense Mapping Agency Aerospace Center (DMAAC), St. Louis, used its library of digitized terrain data and a computer program to calculate corrections for all stations to account for terrain to 104 miles (167 km) from the station. The second level of terrain corrections was necessary because the computer program has limitations in accounting for terrain effects near the stations. This made it necessary, for some stations, to use a ring template to calculate the effect of terrain within approximately 3000 feet of these stations. The third level of terrain corrections was applied to those stations where 10 feet or more of relief was observed within 130 feet of the station. For these stations, elevation differences were measured in the field at a distance of 130 feet along six directions from the stations. These data were used to calculate the effect of the very near relief. Figure 3 is a contour map of the CBA which also shows the locations of the gravity stations and approximate rock outcrop line at the edges of the valley.

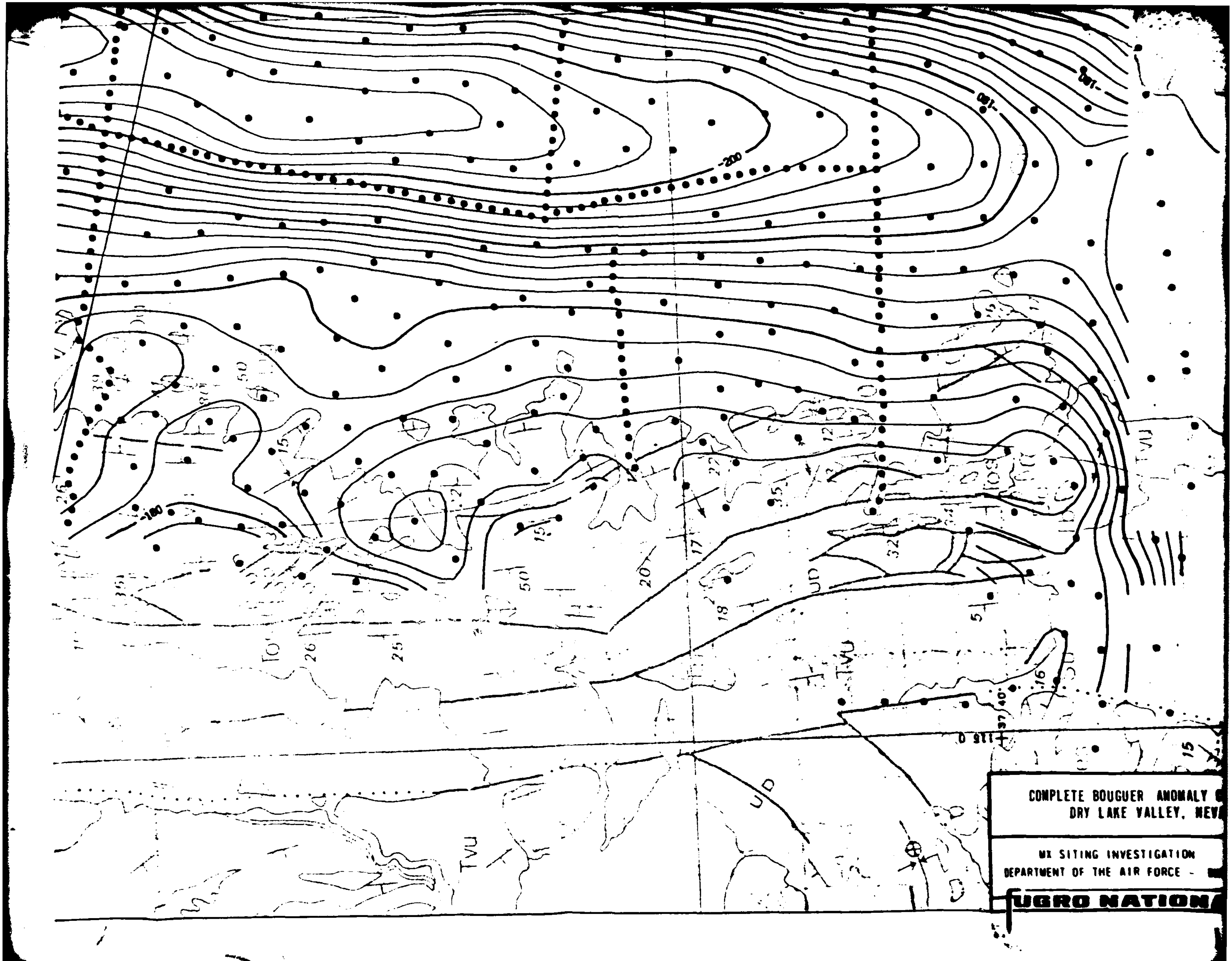


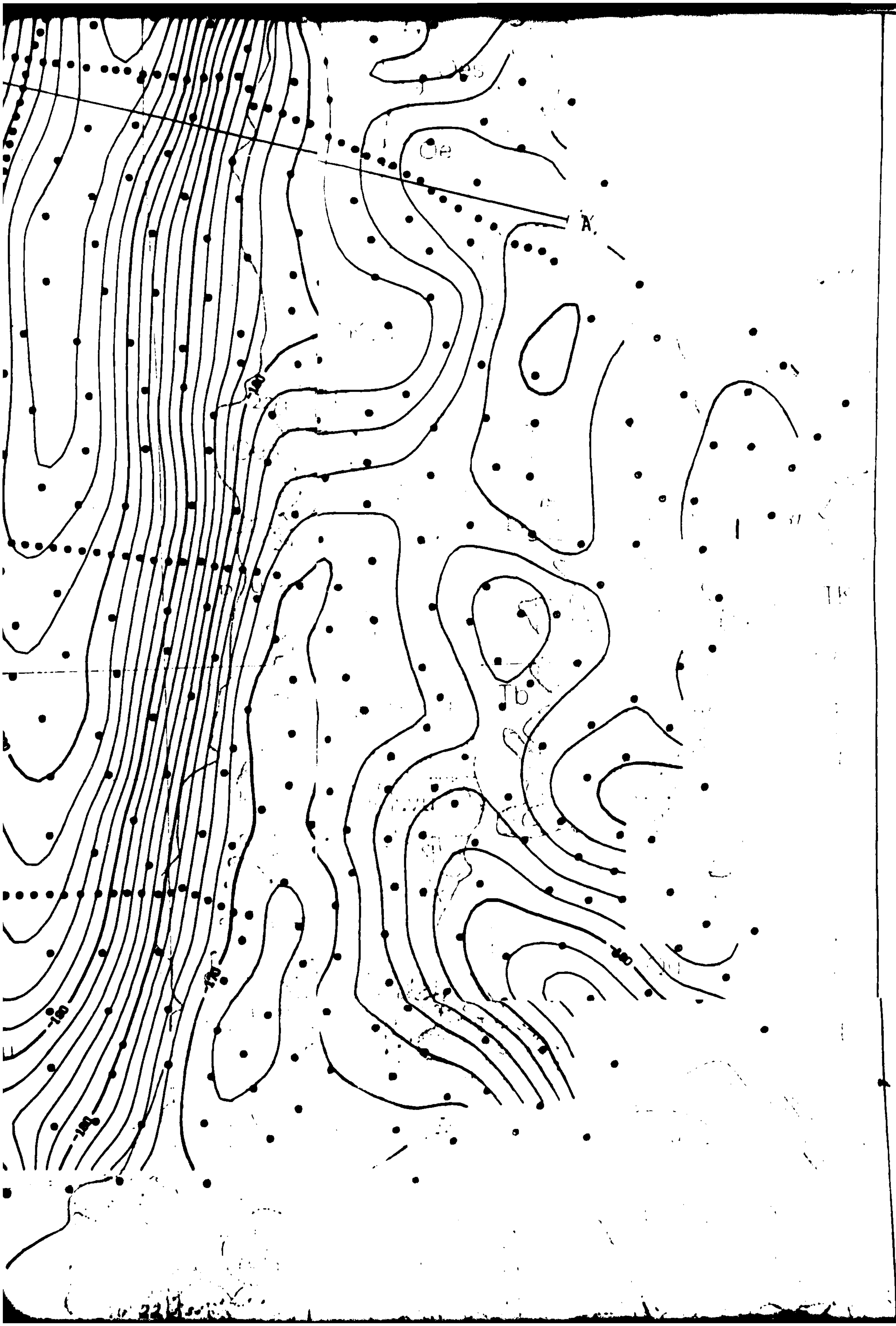
EXPLANATION
DARKENED AREAS ARE ROCK OUTCROPS
CI=2 MILLIGALS
A—A' LINE OF SECTION
GRAVITY STATION
SCALE: 1:125,000
116 0
38 10
Dsl
Ml
Oes
MDp
Tvu
Msw
-200
-190

31 JAN 80



200
200
180
180
200
180
180

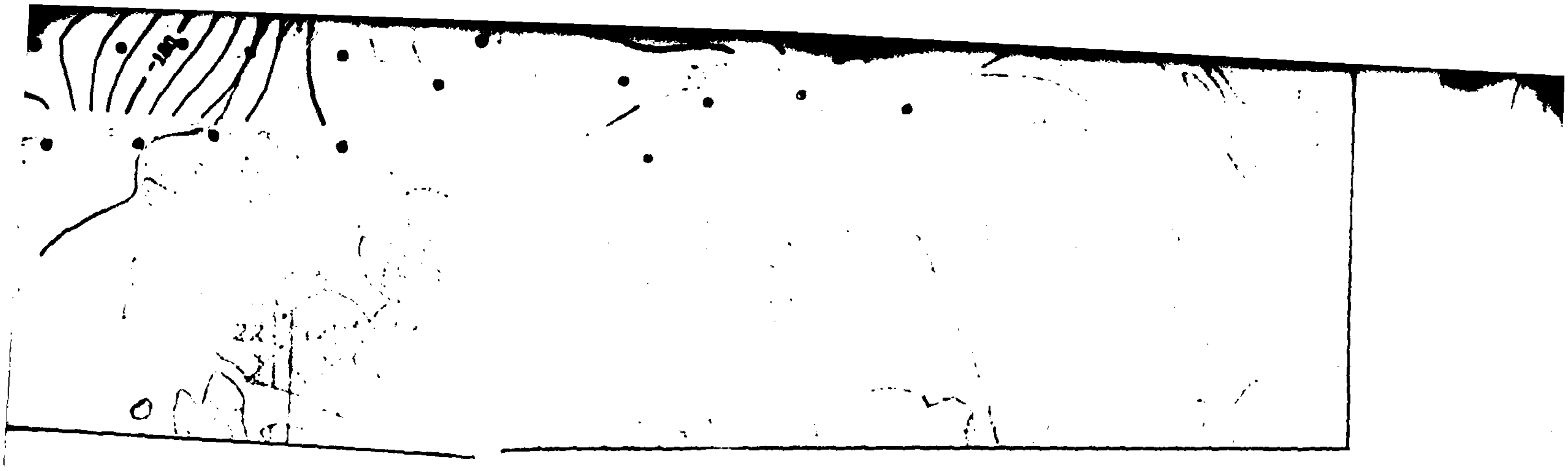

COMPLETE BOUGUER ANOMALY
DRY LAKE VALLEY, NEV
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE -
UGRO NATION
-200
-180
Tvu
UD
115 0
37 40


Oe
Tb

PLETE BOUGUER ANOMALY CONTOURS
DRY LAKE VALLEY, NEVADA

SITING INVESTIGATION NT OF THE AIR FORCE - BMO	FIGURE 3

RO NATIONAL, INC.



6

3.0 GEOLOGIC SUMMARY

The structural geologic setting, major rock types, and depositional regime of the valley-fill material are important considerations in the interpretation of the gravitational field data. Dry Lake Valley exhibits typical basin and range structure; high angle, normal basement faults, oriented north-south, probably border the North Pahroc Range on the west, and the Bristol, Highland, and Chief ranges on the east. The area between was faulted downward. Stewart, and Carlson (1978) indicate that a north-south trending fault on the eastern side of the valley cuts through the surface alluvium. This is further substantiated by Shawe (1965) and Fugro National, Inc. (1978, FN-TR-26E). Shawe (1965) also mentions transverse faults, near the Dry Lake area, occurring at large angles to the major north-south structural trends.

The outcrops in the mountains on the western side of the valley are predominantly Tertiary ash flow tuffs with some Paleozoic carbonate rocks. Conversely, the eastern mountains are composed primarily of Paleozoic carbonates with minor amounts of Tertiary ash flow tuffs (Stewart, and Carlson, 1978). The Paleozoic carbonate rocks in Nevada are generally reported to be relatively high density, on the order of 2.8 g/cm^3. The volcanic rocks in Nevada are highly variable in density. In general, their density ranges fall between 2.2 and 2.5 g/cm^3.

At the surface, the total valley fill is composed of young and intermediate age alluvial fan deposits (72 percent of surface

area), fluvial and stream terrace deposits (16 percent), playa and older lacustrine deposits (six percent), and undifferentiated fluvial, alluvial, and lacustrine deposits (six percent), (*Fugro National, Inc.* 1978, FN-TR-26e). Except for younger stream channel and playa deposits, the valley fill is late Tertiary and early Quaternary in age. Eakin (1963) describes, the valley fill as consisting of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highlands, and including some rocks of volcanic origin.

4.0 INTERPRETATION

The gravitational effect of the light weight material filling the Dry Lake structural basin dominates the CBA map in Figure 3. The CBA values become increasingly negative toward the center of the valley.

4.1 REGIONAL-RESIDUAL SEPARATION

A fundamental step in gravity interpretation is evaluation of the portion of the CBA which represents the geologic feature of interest, in this case, the relatively low density valley fill. The part of the gravity field which is of interest is called the "residual" anomaly. The magnitude of the residual anomaly is a product of: 1) the thickness of alluvial fill; and 2) the contrast in density between the fill and bedrock.

The residual anomaly was isolated by first estimating the way the CBA field would have appeared if there had been no valley fill present. This estimated field is called the "regional" gravity. For this study, the regional field was calculated by fitting (by least squares) a second-order polynomial surface to the CBA values at the bedrock stations around the valley. The regional field was then subtracted from the CBA. The remainder was the residual anomaly.

4.2 DENSITY SELECTION

To calculate the thickness of alluvium which caused the residual anomaly, it is necessary to know the density contrast between the alluvial fill and the bedrock. Only very generalized

information on densities is available, and, for calculation, they were treated as if they are constant throughout the valley. Upon consideration of these factors, it becomes clear that the thickness of alluvium (or depth to rock) interpretation is a coarse approximation.

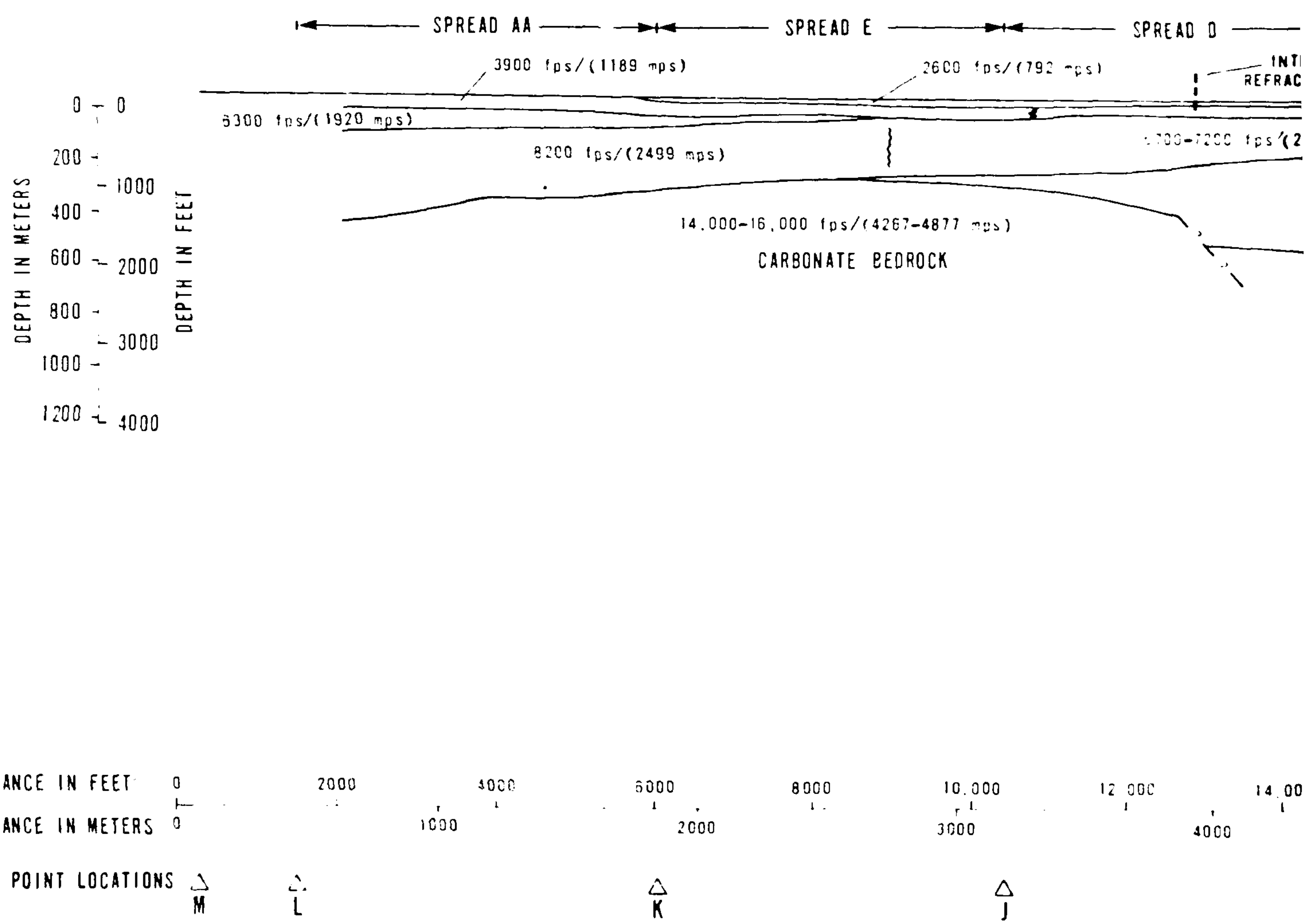
Interpretations from the two seismic refraction lines in the northern end of the valley were used to constrain the selection of the density contrast. These interpretations are shown in Figures 4 and 5. The highest velocities in the profiles are on the order of 15,000 fps (4572 mps). These were interpreted to represent carbonate bedrock. By "trial and error" calculations, it was found that use of a density contrast of 0.45 g/cm^3 caused the depth calculated from the gravity to approximately agree with the seismic interpretation.

The density measured for samples of alluvial fill obtained from shallow borings in Dry Lake Valley range from 2.1 g/cm^3 to 2.4 g/cm^3. Published values for carbonate rocks typically range between 2.6 and 2.8 g/cm^3. The contrast of 0.45 g/cm^3 appears to be reasonable in light of these typical values. This contrast should be considered a maximum, because the average density of the alluvial materials will become greater as the depth of burial increases.

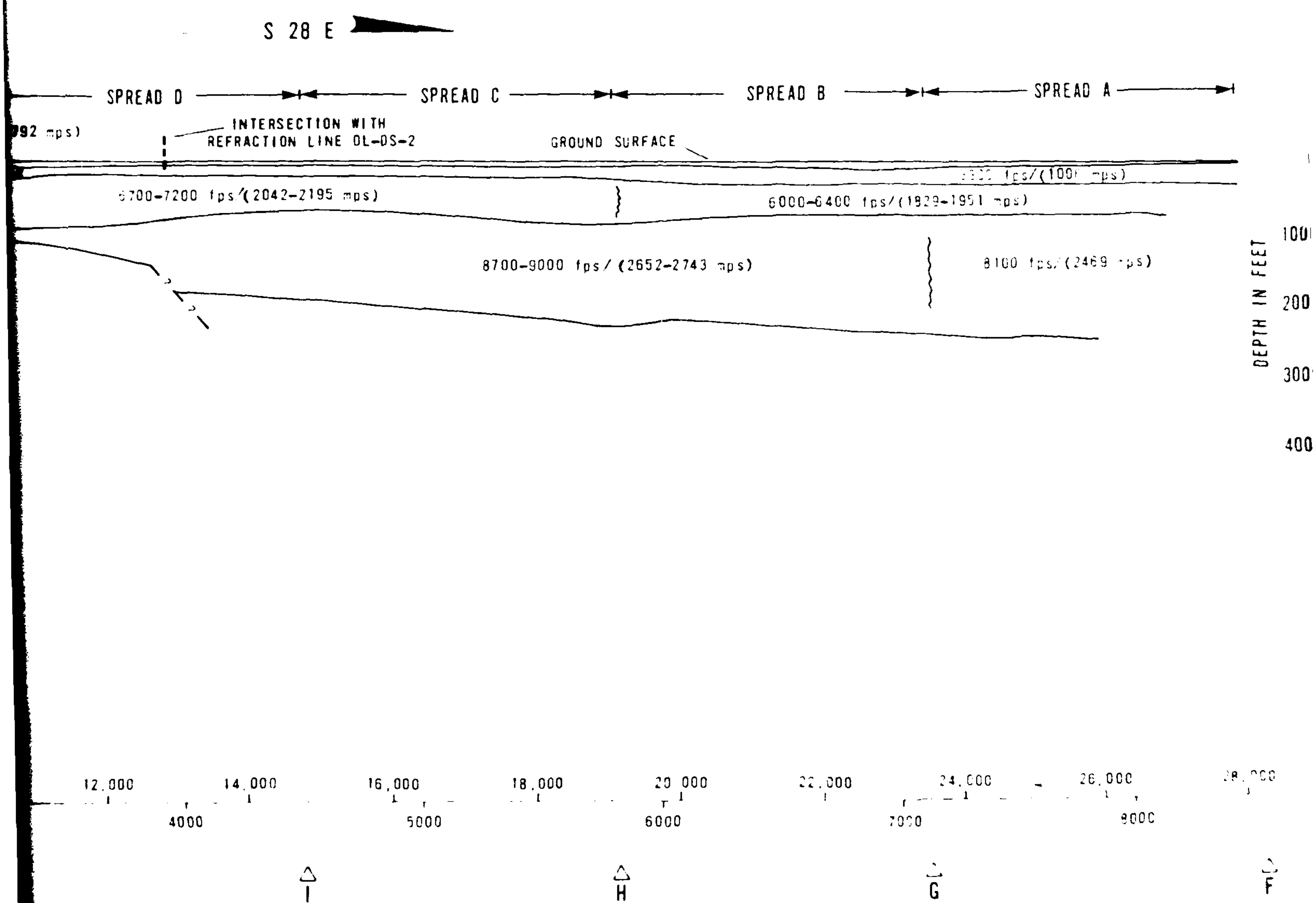
4.3 MODELING

For computation and contouring, values for surface elevations and CBA were interpolated at the nodes of a regular 1 mile (1.6 km) grid over the valley. Portions of the grid, where

VELOC
SEISMIC REFRA



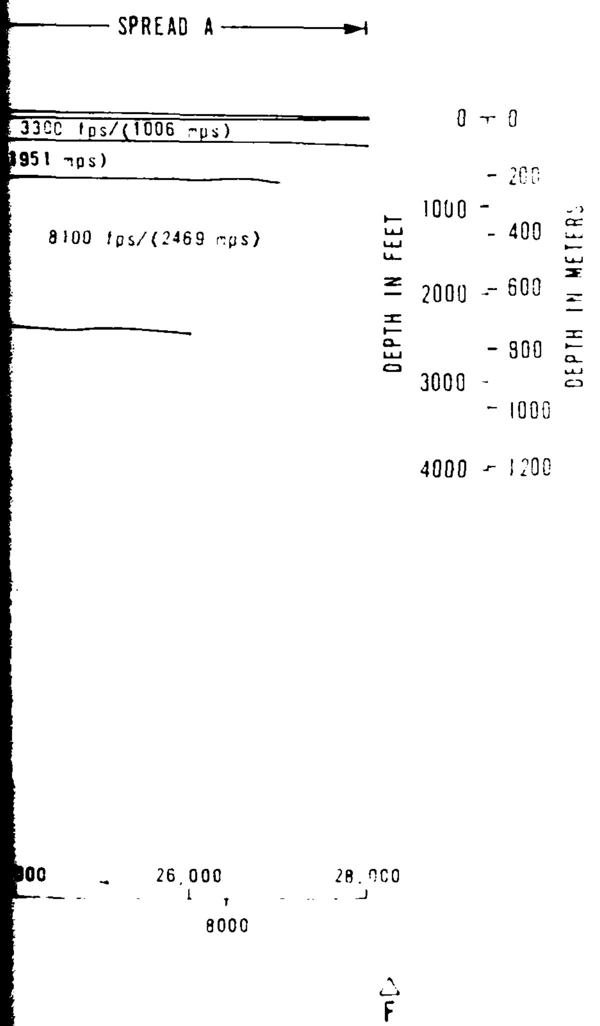
VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-1



VELOCITY PROFIL
SEISMIC REFRACTION LIN
DRY LAKE VALLEY N

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE

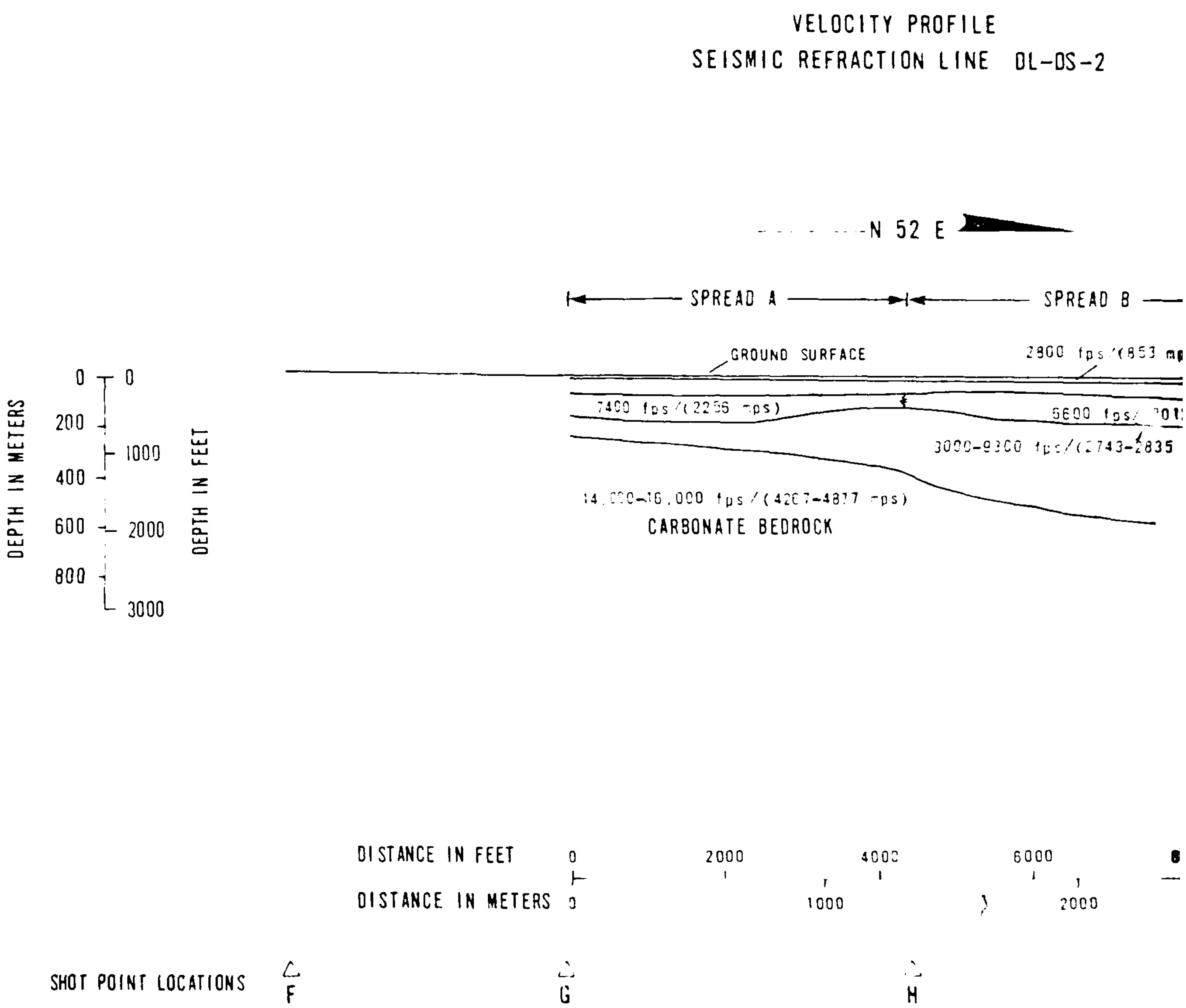
FUGRO NATION



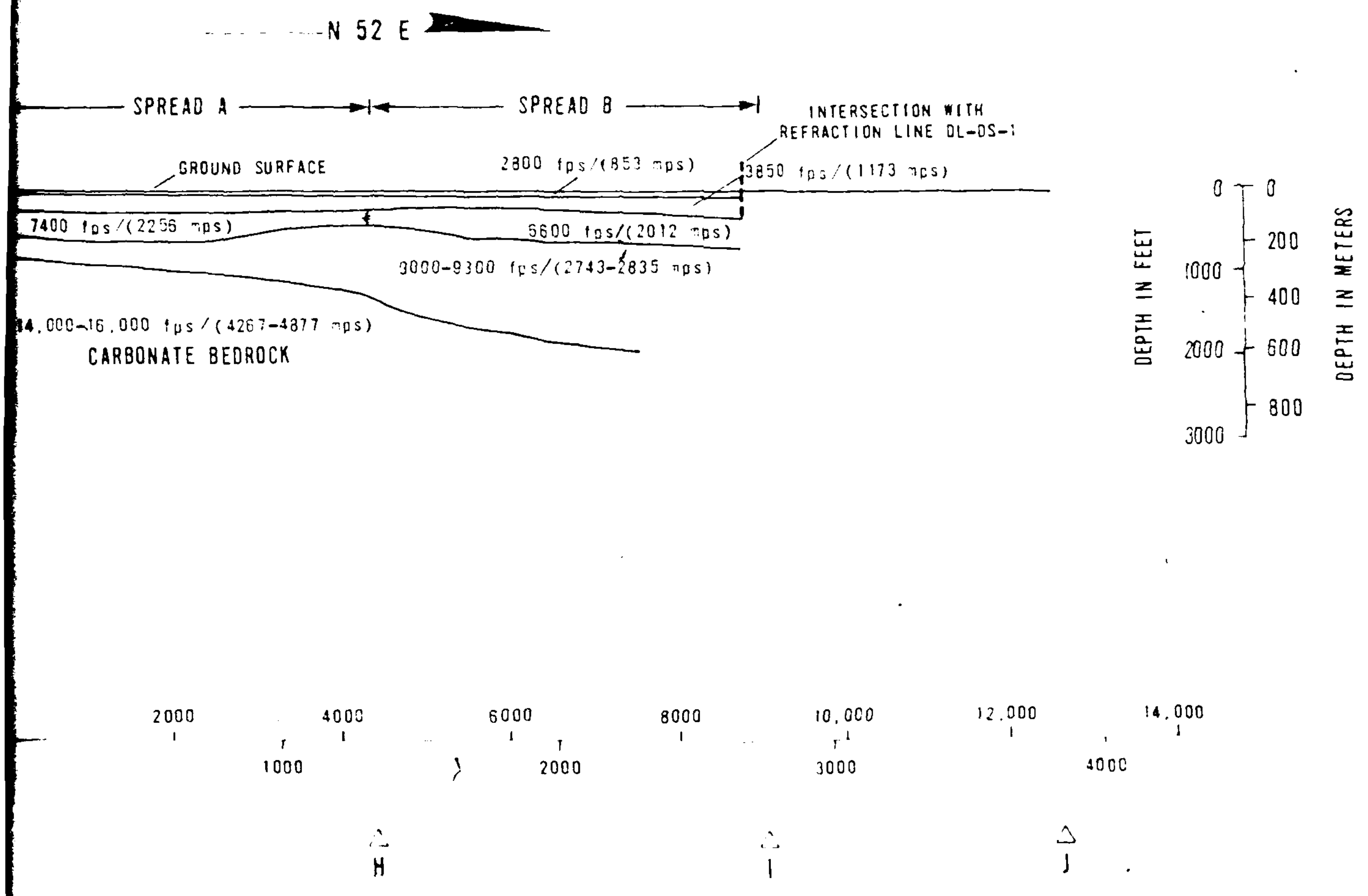
VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-1
DRY LAKE VALLEY NEVADA

MX SITING INVESTIGATION DEPARTMENT OF THE AIR FORCE BMO	FIGURE 4

FUGRO NATIONAL, INC.


VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2
N 52 E
SPREAD A
SPREAD B
GROUND SURFACE
2800 fps/(853 mps
7400 fps/(2256 mps)
6600 fps/
3000-9300 fps/(2743-2835
14,000-16,000 fps/(4267-4877 mps)
CARBONATE BEDROCK
DEPTH IN METERS
DEPTH IN FEET
0
200
400
600
800
0
1000
2000
3000
DISTANCE IN FEET
0
2000
4000
6000
DISTANCE IN METERS
0
1000
2000
SHOT POINT LOCATIONS
F
G
H

VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2



VELOCITY PROFILE
SEISMIC REFRACTION LINE DL-DS-2
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - SAMSO

FIGURE
5

FUGRO NATIONAL, INC.

there were insufficient station data to establish reliable nodal values, were masked out.

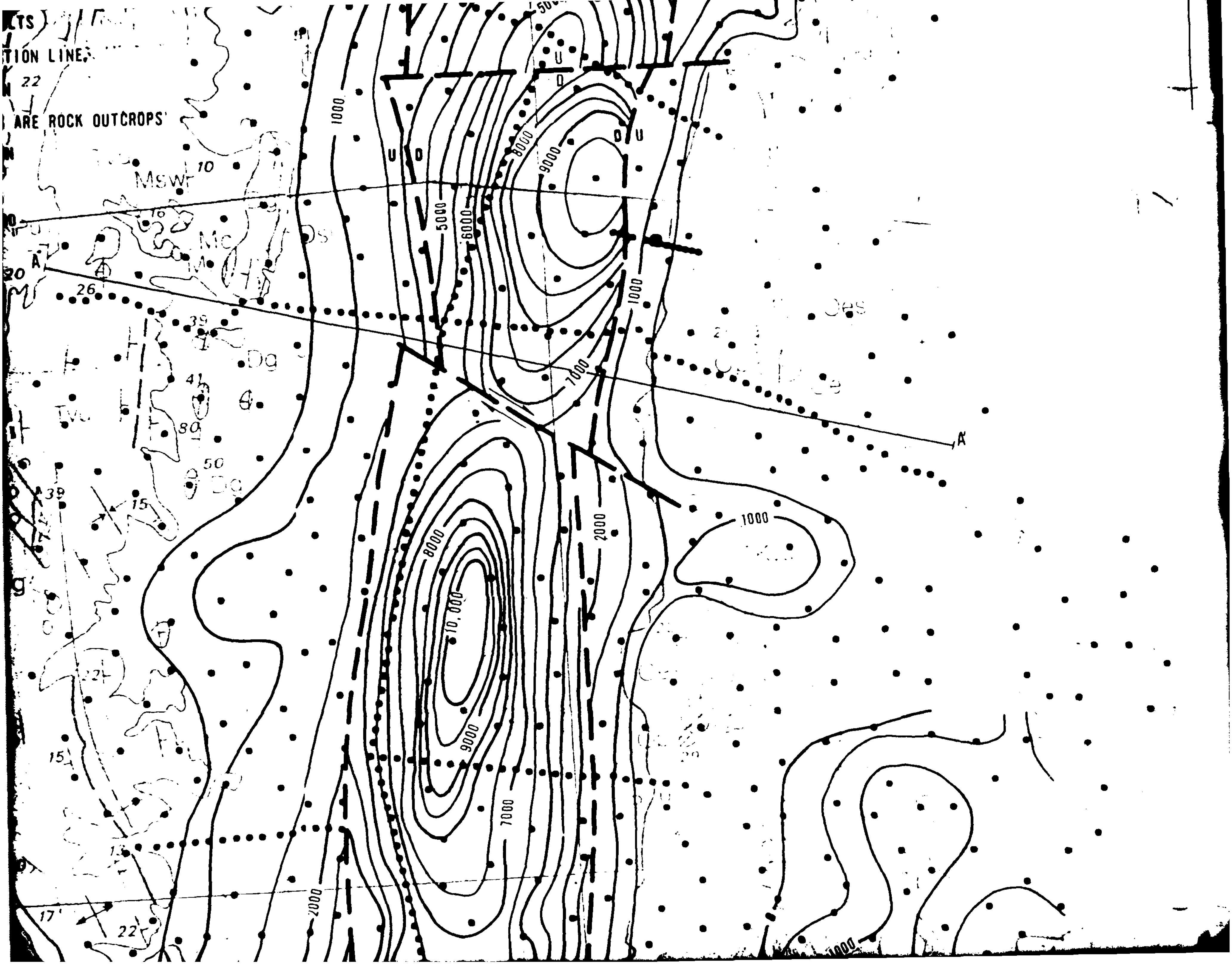
Bedrock depths at each node were computed by iterative computer programs that considered the gravity effect from the model at the other nodes as well as beneath the node in question. Contours showing the interpreted depth to bedrock are displayed in Figure 6. The CBA contours in Figure 3 show linear gradients along both sides of the valley. These gradients range from 10 to 14 milligals per mile. These gradients are thought to be produced by large, steep bedrock faults. The second vertical derivative of the CBA field was calculated to guide the placement of the faults shown in Figure 6. Since the zero contour of the second vertical derivative marks the steepest part of the input CBA field, the faults were placed along the zero contour. This places the trace of the eastern boundary fault slightly more than 1 mile (1.6 km) west of surface cracks in the alluvium mapped as a fault along the eastern boundary of Dry Lake Valley.

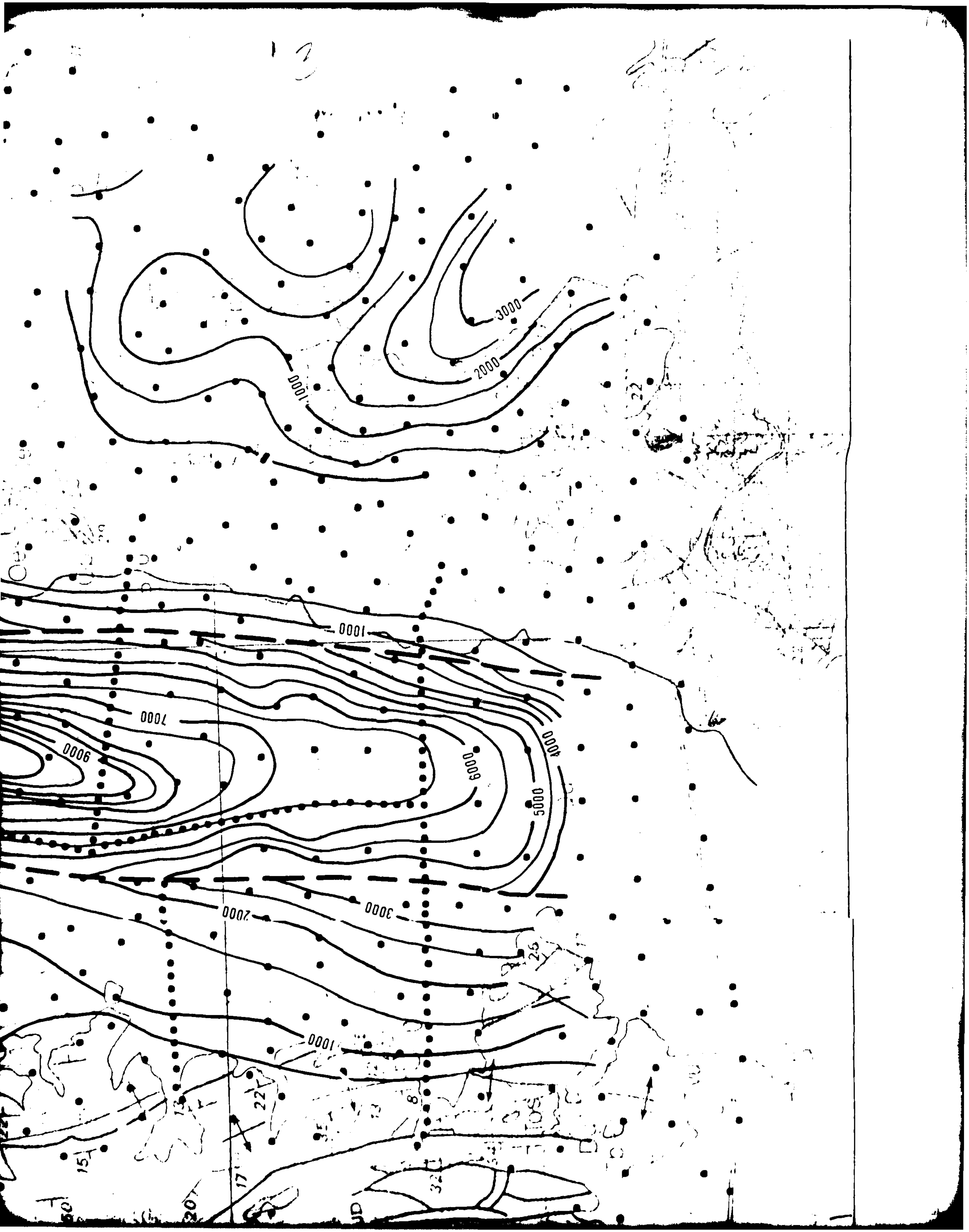
The two faults interpreted to cross the valley are not so clearly defined as the boundary faults. They are positioned where changes in strike of the major gravity gradients and the axis of the valley occur. There is significant change in bedrock elevation associated with the northern transverse fault, but little, if any vertical change across the southern fault.

A cross-section view across the central part of the valley (Section AA', Figures 3 and 6) is shown in Figure 7. The top

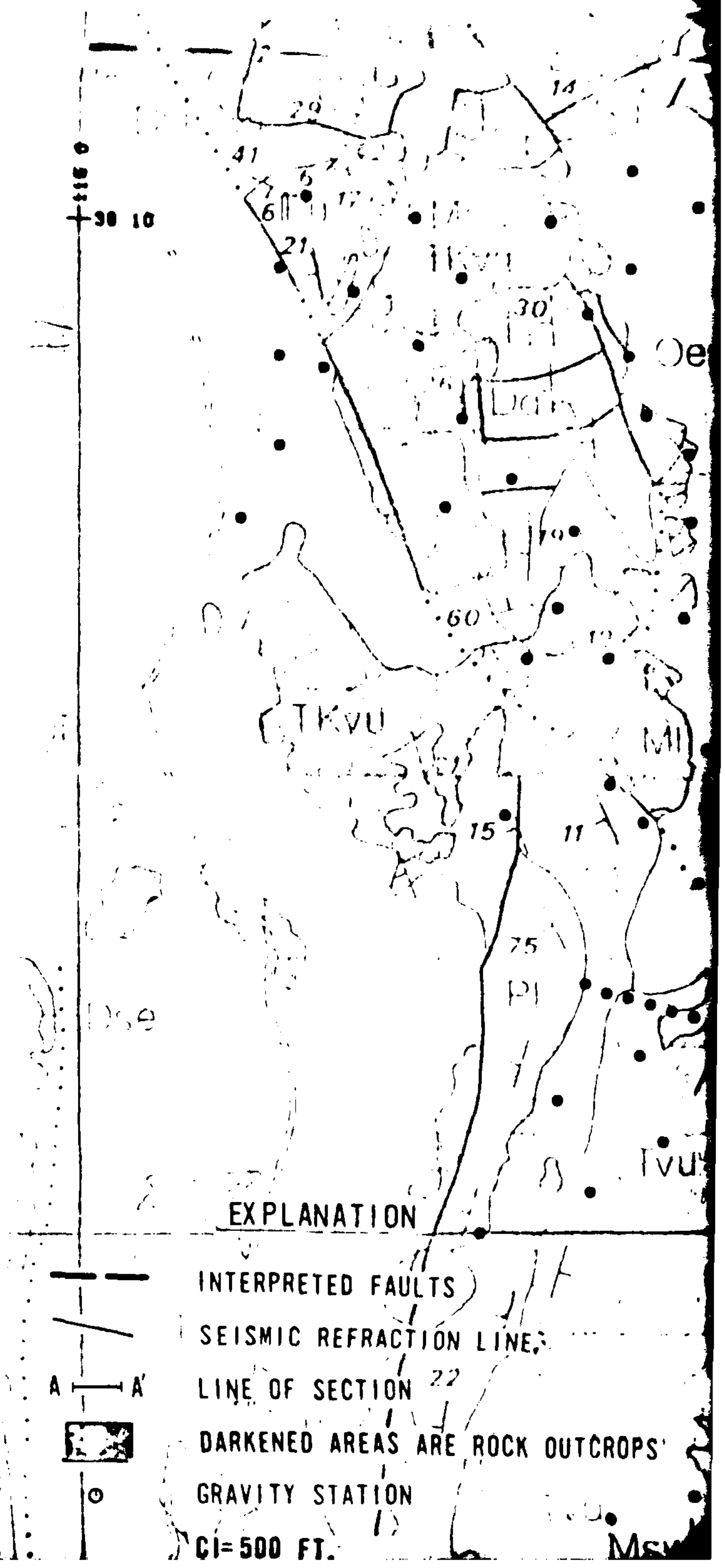
part of the figure shows the shape of the CBA profile along this section. The lower part shows the surface profile and the interpreted bedrock profile.

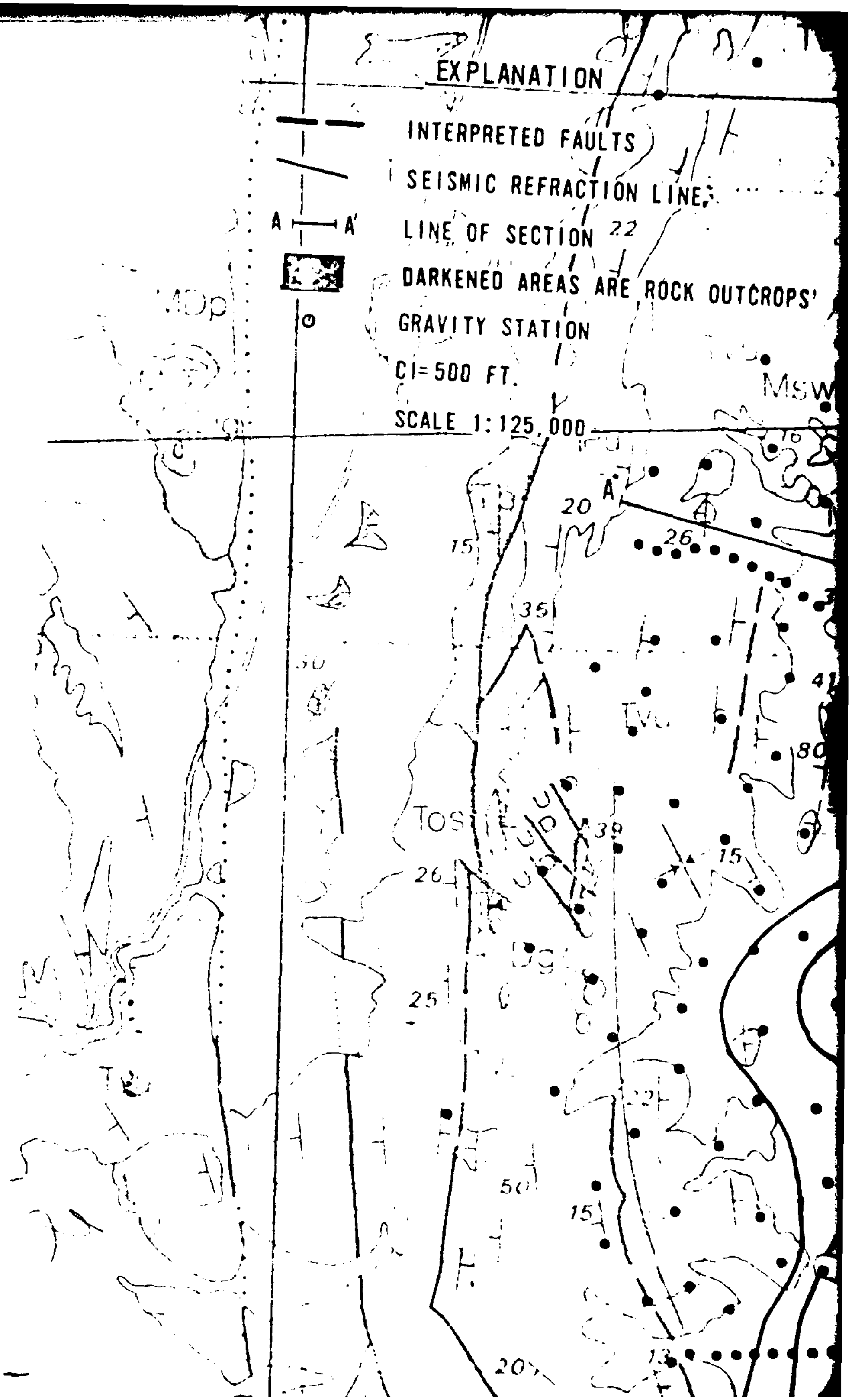
1000
2000
3000
4000
5000
8000
9000
DL-DS-1
DL-DS-2
U
D
MDp
Dq
Oes
Oe
Ml
Pl
Tb
Tvu
Msw
ULTS
TION LINES
ARE ROCK OUTCROPS

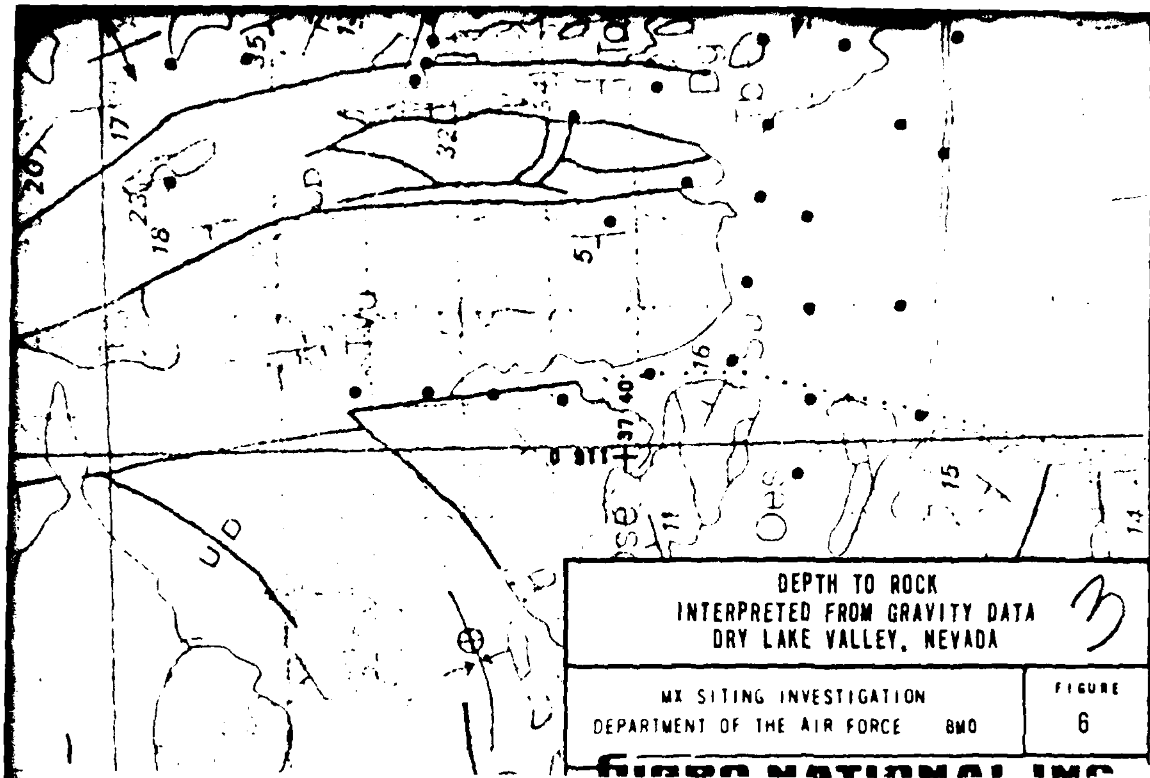

TS)
TION LINE
ARE ROCK OUTCROPS
1000
2000
5000
6000
7000
8000
9000
10,000
U
D
A
A'
Msw
Mc
Ds
Dg
22
10
16
26
39
41
80
50
15
17



3000
2000
1000
1000
7000
9000
6000
5000
4000
3000
2000
1000


116 0
30 10
TKvu
Ml
Pl
Dse
Tvu
Oe
EXPLANATION
INTERPRETED FAULTS
SEISMIC REFRACTION LINE
A A'
LINE OF SECTION
DARKENED AREAS ARE ROCK OUTCROPS
GRAVITY STATION
CI=500 FT.


EXPLANATION
INTERPRETED FAULTS
SEISMIC REFRACTION LINE
A A' LINE OF SECTION
DARKENED AREAS ARE ROCK OUTCROPS
GRAVITY STATION
CI=500 FT.
SCALE 1:125,000
Msw
Tos
Tvu
Dg
MDp

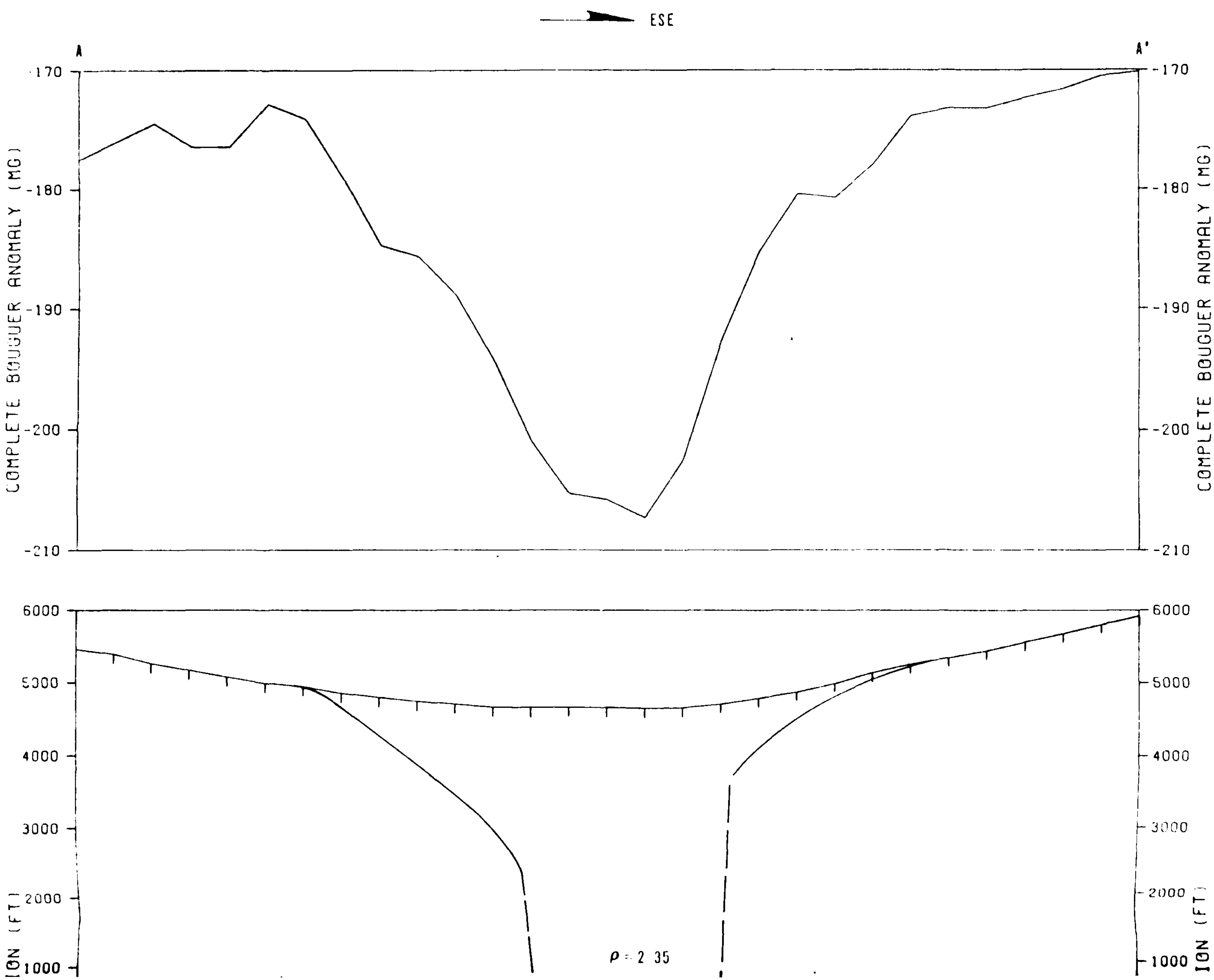


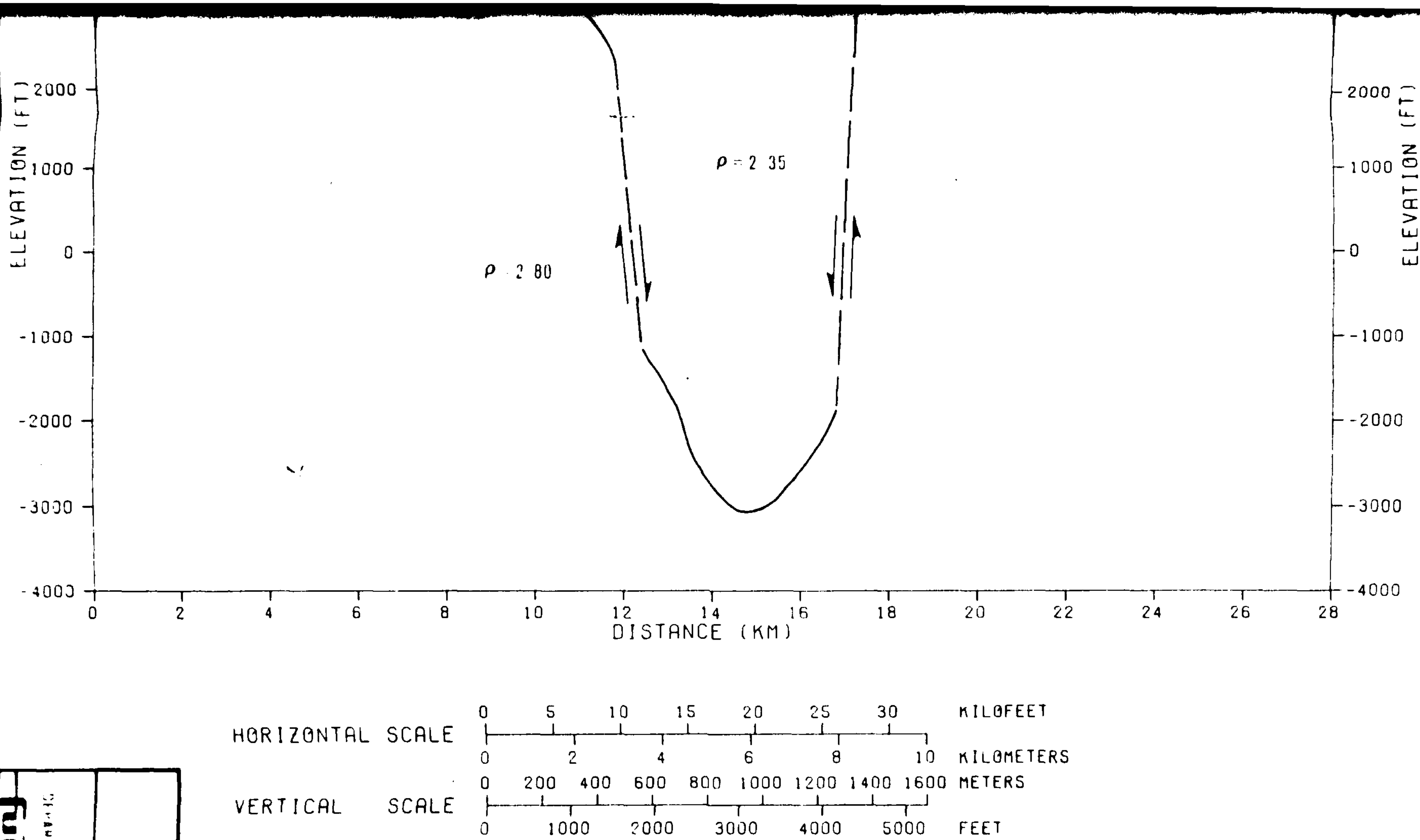
DEPTH TO ROCK
INTERPRETED FROM GRAVITY DATA
DRY LAKE VALLEY, NEVADA

3

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE BMO

FIGURE 6


ESE
A
A'
COMPLETE BOUGUER ANOMALY (MG)
-170
-180
-190
-200
-210
6000
5000
4000
3000
2000
1000
ION (FT)
ρ = 2 35



EXPLANATION

TOP COMPLETE BOUGUER ANOMALY (INTERPOLATED)

BOTTOM ELEVATION: INTERPOLATED SURFACE ELEVATIONS

MODEL OF BEDROCK SURFACE

DENSITY VALUES (ρ 2.3) g/cm^3

DISTANCE SCALE 1:125,000

CROSS-SECTIONAL VIEW, PROFILE AA'
DRY LAKE VALLEY, NEVADA

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

FIGURE 7

FUGRO NATIONAL, INC.

5.0 CONCLUSIONS

The interpretation of the gravity survey of Dry Lake Valley indicates that there are major range bounding normal faults on both sides of the valley. The graben between the boundary faults is calculated to be on the order of 10,000 feet deep. The northern third of the valley is substantially shallower than the southern part.

There is a large, well defined negative gravity anomaly associated with Dry Lake Valley. An average density contrast of 0.45 g/cm^3 between the alluvium and bedrock was used to calculate the thickness of alluvium which would create such an anomaly. If a smaller contrast had been used, the calculated thickness would have been greater. Conversely, if a larger contrast had been used, the calculated thickness would have been smaller.

Additional modeling with other density contrasts was not justified because so little is known about the actual density distribution in and around the valley.

If future studies acquire better density data or actual thicknesses of alluvium in relatively deep parts of the basin, the gravity interpretation can be refined and made more accurate.

BIBLIOGRAPHY

Eakin, T.E., 1963, Ground Water Appraisal of Dry Lake and Delamar Valleys: U.S. Geol. Survey, Ground Water Resources - Reconnaissance Series, Report 16, 24 p.

Fugro National, Inc. 1978, MX siting investigation geotechnical summary prime characterization sites, Great Basin Candidate Siting Province Report, 70 p., 4 appendices (FN-TR-26e).

Shawe, D.R., 1965, Strike-slip control of basin-range structure indicated by historical faults in Western Nevada: Geological Society of America Bulletin, Vol. 76, pp. 1361-1378.

Stewart, J.H., and Carlson, J.E., 1978, Geologic Map of Nevada: U.S. Geol. Survey, 1:500,000.

APPENDIX A1.0

GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.0 GENERAL PRINCIPLES OF THE GRAVITY EXPLORATION METHOD

A1.1 GENERAL

A gravity survey involves measurement of differences in the gravitational field between various points on the earth's surface. The gravitational field values being measured are the same as those influencing all objects on the surface of the earth. They are generally associated with the force which causes a 1 gm mass to be accelerated at 980 cm/sec^2. This force is normally referred to as a 1 g force.

Even though in many applications the gravitational field at the earth's surface is assumed to be constant, small but distinguishable differences in gravity occur from point to point. In a gravity survey, the variations are measured in terms of milligals. A milligal is equal to 0.001 cm/second^2 or 0.00000102 g. The differences in gravity are caused by geometrical effects, such as differences in elevation and latitude, and by lateral variations in density within the earth. The lateral density variations are a result of changes in geologic conditions. For measurements at the surface of the earth, the largest factor influencing the pull of gravity is the density of all materials between the center of the earth and the point of measurement.

To detect changes produced by differing geological conditions, it is necessary to detect differences in the gravitational field as small as a few milligals. To recognize changes due to

geological conditions, the measurements are "corrected" to account for changes due to differences in elevation and latitude.

Given this background, the basic concept of the gravitational exploration method, the anomaly, can be introduced. If, instead of being an oblate spheroid characterized by complex density variations, the earth were made up of concentric, homogeneous shells, the gravitational field would be the same at all points on the surface of the earth. The complexities in the earth's shape and material distribution are the reason that the pull of gravity is not the same from place to place. A difference in gravity between two points which is not caused by the effects of known geometrical differences, such as in elevation, latitude, and surrounding terrain, is referred to as an "anomaly."

An anomaly reflects lateral differences in material densities. The gravitational attraction is smaller at a place underlain by relatively low density material than it is at a place underlain by a relatively high density material. The term "negative gravity anomaly" describes a situation in which the pull of gravity within a prescribed area is small compared to the area surrounding it. Low-density alluvial deposits in basins such as those in the Nevada-Utah region produce negative gravity anomalies in relation to the gravity values in the surrounding mountains which are formed by more dense rocks.

The objective of gravity exploration is to deduce the variations in geologic conditions that produce the gravity anomalies identified during a gravity survey.

A1.2 INSTRUMENTS

The sensing element of a LaCoste and Romberg gravimeter is a mass suspended by a zero-length spring. Deflections of the mass from a null position are proportional to changes in gravitational attraction. These instruments are sealed and compensated for atmospheric pressure changes. They are maintained at a constant temperature by an internal heater element and thermostat. The absolute value of gravity is not measured directly by a gravimeter. It measures relative values of gravity between one point and the next. Gravitational differences as small as 0.01 milligal can be measured.

A1.3 FIELD PROCEDURES

The gravimeter readings were calibrated in terms of absolute gravity by taking readings twice daily at nearby USGS gravity base stations. Gravimeter readings fluctuate because of small time-related deviations due to the effect of earth tides and instrument drift. Field readings were corrected to account for these deviations. The magnitude of the tidal correction was calculated using an equation suggested by Goguel (1954):

$$C = P + N\cos\phi\,(\cos\phi + \sin\phi) + S\cos\phi\,(\cos\phi - \sin\phi)$$

where C is the tidal correction factor, P, N, and S are time-related variables, and ϕ is the latitude of the observation point. Tables giving the values of P, N, and S are published annually by the European Association of Exploration Geophysicists.

The meter drift correction was based on readings taken at a designated base station at the start and end of each day. Any difference between these two readings after they were corrected for tidal effects was considered to have been the result of instrumental drift. It was assumed that this drift occurred at a uniform rate between the two readings. Corrections for drift were typically only a few hundredths of a milligal. Readings corrected for tidal effects and instrumental drift represented the observed gravity at each station. The observed gravity values represent the total gravitational pull of the entire earth at the measurement stations.

A1.4 DATA REDUCTION

Several corrections or reductions are made to the observed gravity to isolate the portion of the gravitational pull which is due to the crustal and near-surface materials. The gravity remaining after these reductions is called the "Bouguer Anomaly." Bouguer Anomaly values are the basis for geologic interpretation. To obtain the Bouguer Anomaly, the observed gravity is adjusted to the value it would have had if it had been measured at the geoid, a theoretically defined surface which approximates the surface of mean sea level. The difference between the "adjusted" observed gravity and the gravity at the geoid calculated for a theoretically homogeneous earth is the Bouguer Anomaly.

Four separate reductions, to account for four geometrical effects, are made to the observed gravity at each station to arrive at its Bouguer Anomaly value.

a. Free-Air Effect: Gravitational attraction varies inversely as the square of the distance from the center of the earth. Thus corrections must be applied for elevation. Observed gravity levels are corrected for elevation using the normal vertical gradient of:

$$FA = -0.09406 \text{ mg/ft } (-0.3086 \text{ milligals/meter})$$

where FA is the free-air effect (the rate of change of gravity with distance from the center of the earth). The free-air correction is positive in sign since the correction is opposite the effect.

b. Bouguer Effect: Like the free-air effect, the Bouguer effect is a function of the elevation of the station, but it considers the influence of a slab of earth materials between the observation point on the surface of the earth and the corresponding point on the geoid (sea level). Normal practice, which is to assume that the density of the slab is 2.67 grams per cubic centimeter was followed in these studies. The Bouguer correction (B_c), which is opposite in sign to the free-air correction, was defined according to the following formula.

$$B_c = 0.01276\ (2.67)\ h_f \text{ (milligals per foot)}$$

$$B_c = 0.04185\ (2.67)\ h_m \text{ (milligals per meter)}$$

where h_f is the height above sea level in feet and h_m is the height in meters.

c. Latitude Effect: Points at different latitudes will have different "gravities" for two reasons. The earth (and the geoid) is spheroidal, or flattened at the poles. Since points at higher latitudes are closer to the center of the earth than points near the equator, the gravity at the higher latitudes is larger. As the earth spins, the centrifugal acceleration causes a slight decrease in gravity. At the higher latitudes where the earth's radii are smaller, the centrifugal acceleration diminishes. The gravity formula for the Geodetic Reference System, 1967, gives the theoretical value of gravity at the geoid as a function of latitude. It is:

$$g = 978.0381\ (1 + 0.0053204 \sin^2 \phi - 0.0000058 \sin^2 2\phi)\ \text{gals}$$

where g is the theoretical acceleration of gravity and ϕ is the latitude in degrees. The positive term accounts for the spheroidal shape of the earth. The negative term adjusts for the centrifugal acceleration.

The previous two corrections (free air and Bouguer) have adjusted the observed gravity to the value it would have had at the geoid (sea level). The theoretical value at the geoid for the latitude of the station is then subtracted from the adjusted observed gravity. The remainder is called the Simple Bouguer Anomaly (SBA). Most of this gravity represents the effect of material beneath the station, but part of it may be due to irregularities in terrain (upper part of the Bouguer slab) away from the station.

d. Terrain Effect: Topographic relief around the station has a negative effect on the gravitational force at the station. A nearby hill has upward gravitational pull and a nearby valley contributes less downward attraction than a nearby material would have. Therefore, the corrections are always positive. Corrections are made to the SBA when the terrain effects were 0.1 milligal or larger. Terrain corrected Bouguer values are called the Complete Bouguer Anomaly (CBA). When the CBA is obtained, the reduction of gravity at individual measurement points (stations) is complete.

A1.5 INTERPRETATION

The first step in interpretation is to separate the portion of the CBA that might be caused by the lightweight, basin-fill material overlying the heavier bedrock material which forms the surrounding mountains and presumably the basin floor. Since the valley-fill sediments are absent at the stations read in the mountains, the CBA values at these bedrock stations are used as the basis for constructing a regional field over the valley. A regional field is an estimation of the values the CBA would have had if the light weight sediments (the anomaly) had not been there.

The difference between the CBA and the regional field is called the "residual" field or residual anomaly. The residual field is the interpreter's estimation of the gravitational effect of the geologic anomaly. The zero value of the residual anomaly is not exactly at the rock outcrop line but at some

distance on the "rock" side of the contact. The reason for this is found in the explanation of the terrain effect. There is a component of gravitational attraction from material which is not directly beneath a point.

If the "regional" is well chosen, the magnitude of the residual anomaly is a function of the thickness of the anomalous (fill) material and the density contrast. The density contrast is the difference in density between the alluvial and bedrock material. If this contrast were known, an accurate calculation of the thickness could be made. In most cases, the densities are not well known and they also vary within the study area. In these cases, it is necessary to use typical densities for materials similar to those in the study area.

If the selected average density contrast is smaller than the actual density contrast, the computed depth to bedrock will be greater than the actual depth and vice-versa. The computed depth is *inversely proportional to the density contrast*. A *ten* percent error in density contrast produces a ten percent error in computed depth. An iterative computer program is used to calculate a subsurface model which will yield a gravitational field to match (approximately) the residual gravity anomaly.

APPENDIX A2.0

LISTS OF GRAVITY DATA

FN-TR-33-DL

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV	THEO GRAV FAA	CBA +1000
DL1	+38 767+1145234	5377Y	0	127422193	68649148289200331	98562	60349
DL2	+38 771+1145117	5225Y	0	107422204	68620149343200338	98179	80465
DL3	+38 793+114501551591T		0	103422249	68966149601200370	97963	80490
DL4	+38 833+114490751509T		0	119422323	68993149694200428	97943	80495
DL5	+38 808+1144852	5634Y	0	194422282	69206147022200391	99654	80536
DL6	+38 807+1144744	5279B	0	111422284	69364149231200390	98522	80628
DL7	+38 798+1144630	5342B	0	114422271	69530148685200377	98583	80477
DL8	+38 751+1144505	5548Y	0	114422189	69715147527200306	99434	80625
DL9	+38 861+1144550	5665Y	0	115422391	69045146910200469	99757	80551
DL10	+38 880+1144672	5600C	0	112422421	69465147333200497	99540	80552
DL11	+38 892+1144773	5584Y	0	111422440	69317147360200515	99594	80465
DL12	+38 899+1144698	5251C	0	106422449	69135149690200525	98584	80780
DL13	+38 914+114499951860T		0	133422473	68986149923200547	98182	80627
DL14	+38 869+1145118	5304Y	0	110422386	68614148775200480	98212	80231
DL15	+38 846+1145199	5365C	0	110422344	68697149051200450	99286	81023
DL16	+38 929+1145195	5438Y	0	122422494	68699148263200569	98673	80447
DL17	+38 955+1145116	5354Y	0	126422545	68614148625200607	98406	80271
DL18	+38 939+1144939	5565Y	60	152422521	69080147274200584	99253	80423
DL19	+38 966+1144537	5409Y	0	94422575	69221148317200623	99165	80606
DL20	+38 944+1144669	5826Y	0	131422540	69467145931200591100172		80436
DL21	+38 946+1144558	5934Y	0	175422547	69629145199200594100454		80390
DL22	+38 991+1144572	5847Y	0	110422630	69607145911200659100281		80457
DL23	+381024+1144658	5628Y	0	97422688	69480147027200706	99287	80186
DL24	+381013+1144752	5449Y	0	128422665	69343148410200691	99001	80544
DL25	+381034+1144876	5632Y	47	112422699	69161146677200723	99159	80108
DL26	+381003+1144982	5225Y	0	129422638	69007149752200677	98249	80557
DL27	+381011+1145128	5424Y	0	123422648	68794145377200689	98735	80359
DL28	+381012+1145223	5580Y	0	137422647	68655147812200690	99637	80743
DL30	+381104+1145069	5445Y	0	128422622	68876148536200825	98956	80514
DL31	+381090+1144957	5271Y	0	126422600	69040149615200805	97618	79960
DL32	+381074+1144762	5697Y	0	114422777	69325146401200781	99297	79961
DL33	+381084+1144672	5534Y	0	101422799	69450147850200795	99147	80573
DL34	+381079+1144570	5711Y	0	104422793	69630147210200788100171		80796
DL36	+38 55+1145100	5153Y	0	158420881	68676149419199290	99124	81707
DL38	+38 80+1145084	5103C	0	113420928	68896149925199327	99188	81691
DL39	+38 71+1145059	5090C	0	163420912	68935150360199313	98919	81796
DL40	+38 63+1145033	5043C	0	124420698	68973150511199302	98659	81535
DL41	+38 55+1145006	5000C	0	116420684	69013150512199290	98277	81335
DL42	+38 46+1144980	4962C	0	113420668	69052150960199277	98205	81475
DL43	+38 38+1144954	4922C	0	108420654	69090151582199265	98036	81956
DL44	+38 30+1144928	4925B	0	105420640	69126151714199253	98410	82117
DL45	+38 21+1144902	4858B	0	108420625	69167152018199240	98496	82035
DL46	+38 13+1144870	4848B	0	111420811	69202151697199228	98293	81969
DL47	+38 4+1144850	4842B	0	103420795	69244151047199216	98060	81583
DL48	+38 63+1144883	4874Y	0	104420903	69193151395199302	98412	81693
DL49	+38 125+1144937	4942C	0	98421016	69111151365199392	99502	81744
DL50	+38 134+1145032	5134Y	0	99421029	68972150019199405	98960	81546
DL51	+38 169+1145109	5192Y	0	113421091	68868150659199456	99465	81276
DL52	+38 211+1145229	5257B	0	110421165	68682149577199516	99531	81223
DL53	+38 205+1145198	5229B	0	115421155	68726149825199509	99529	81610
DL54	+38 203+1145168	5203Y	0	119421152	68770150190199506	99546	81915
DL55	+38 215+1145141	5178-	0	106421175	68809150314199523	99552	81497
DL56	+38 219+1145114	5147B	0	121421184	68848150510199530	99419	81935
DL57	+38 225+1145088	5122B	0	102421196	68886150688199538	99273	81495
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL59	+38 237	+1145034	5072R	0	98421220	689641505811995 56	98758	81556
DL60	+38 243	+1145007	5050R	0	95421232	690041500461995 65	99607	81476
DL61	+38 249	+1144979	5026R	0	96421244	690441500761995 73	98403	81356
DL62	+38 257	+1144942	5002Y	0	92421260	690981507251995 85	98214	81245
DL63	+38 195	+1145003	5050R	0	100421143	690121506071994 95	98636	81514
DL64	+38 214	+1144897	4957Y	0	93421182	691661511361995 23	98264	81450
DL65	+38 166	+1144857	4912Y	0	99421094	692261515951994 52	98370	81715
DL66	+38 113	+1144796	4865S	0	99420998	693181510731993 75	97070	81106
DL67	+38 23	+1144780	4846S	0	96420833	693451507931992 43	97155	80723
DL68	+38 9	+1144672	4834S	0	97420810	695041502571992 23	96527	80137
DL69	+38 90	+1144719	4865S	0	97420959	694321503401993 41	96783	80287
DL70	+38 1	+1144558	4823S	0	107420800	690711503261992 11	96504	80161
DL71	+38 21	+1144567	4828S	0	110420836	690571503941992 40	96590	80235
DL72	+38 42	+1144577	4836S	0	106420875	6906421[illegible]1992 71	96668	80296
DL73	+38 62	+1144587	4842S	0	103420911	690261504561993 00	96721	80316
DL74	+38 83	+1144597	4847S	0	104420950	690101504031993 30	96747	80319
DL75	+38 103	+1144607	4855S	0	104420987	695951504221993 60	96752	80297
DL76	+38 124	+1144617	4867S	0	107421025	695791503361993 91	96749	80256
DL77	+38 144	+1144626	4878S	0	106421062	695621502431994 20	96873	80199
DL78	+38 163	+1144643	4887S	0	109421096	[illegible]	[illegible]	[illegible]
DL79	+38 181	+1144657	4897S	0	102421129	[illegible]	[illegible]	80127
DL80	+38 200	+1144672	4904S	0	99421164	[illegible]	[illegible]	[illegible]
DL81	+38 219	+1144680	4911U	0	95421196	[illegible]	96791	80150
DL82	+38 237	+1144705	4922S	0	96421231	[illegible]	[illegible]	80227
DL83	+38 256	+1144719	4930S	0	96421266	[illegible]	[illegible]	80262
DL84	+38 275	+1144732	4937S	0	94421300	[illegible]	[illegible]	[illegible]
DL85	+38 294	+1144747	4945S	0	95421335	[illegible]	[illegible]	[illegible]
DL86	+38 313	+1144760	4957S	0	92421370	[illegible]	97293	[illegible]
DL87	+38 334	+1144771	4966S	0	90421408	[illegible]	[illegible]	[illegible]
DL88	+38 355	+1144782	4972U	0	91421447	[illegible]	[illegible]	80613
DL89	+38 330	+1144621	4968Y	0	90421399	692721505881996 92	[illegible]	80795
DL90	+38 315	+1144640	4966S	0	91421370	[illegible]	[illegible]	80923
DL91	+38 297	+1144977	4958U	0	94421336	[illegible]	[illegible]	[illegible]
DL92	+38 284	+1144906	4972S	0	92421311	[illegible]	[illegible]	[illegible]
DL93	+38 270	+1144922	4989C	0	93421284	691271500641996 04	98212	81289
DL94	+38 174	+1144758	4961S	0	98421113	693711500581994 64	97317	80069
DL95	+38 251	+1144814	4937S	0	94421253	692601507961995 77	97582	80037
DL96	+38 93	+1144521	4844S	0	114420971	[illegible]	96757	[illegible]
DL97	+38 164	+1144525	4859Y	0	115421102	[illegible]	96624	80355
DL98	+38 239	+1144594	4900Y	0	109421235	[illegible]	[illegible]	[illegible]
DL99	+38 308	+1144657	4935Y	0	102421364	695131500461996 6[illegible]	96632	80102
DL100	+38 349	+1144561	4978C	0	113421443	[illegible]	[illegible]	[illegible]
DL101	+38 365	+1144756	4952S	0	97421466	[illegible]	97364	80515
DL102	+38 374	+1144730	4971S	0	96421483	[illegible]	[illegible]	[illegible]
DL103	+38 385	+1144702	4967U	0	98421505	[illegible]	[illegible]	[illegible]
DL104	+38 396	+1144082	4970S	0	101421526	[illegible]	97013	[illegible]
DL105	+38 406	+1144061	4982Y	0	100421545	[illegible]	97026	[illegible]
DL106	+38 414	+1144035	4994S	0	106421570	[illegible]	96997	[illegible]
DL107	+38 432	+1144011	5009S	0	108421595	[illegible]	[illegible]	[illegible]
DL108	+38 445	+1145564	5023S	0	103421620	[illegible]	[illegible]	79993
DL109	+38 455	+1144558	5037C	0	113421039	[illegible]	97069	[illegible]
DL110	+38 467	+1114532	5005C	0	110421062	[illegible]	97262	[illegible]
DL111	+38 491	+1144504	5992C	0	123421089	697291494641999 13	97473	[illegible]
DL112	+38 379	+1144702	4982S	0	91421491	693121504851997 64	97617	80706
DL113	+38 394	+1144813	4988S	0	92421518	692811505701997 86	97726	80805
DL114	+38 413	+1144830	5000S	0	92421552	692551500491998 13	97[illegible]	80927
DL115	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN	LONG. DEG MIN	ELEV. +CODE	TER-COR. IN	OUT / NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL116	+38 448	+1144664	5020S	0	91421616	69204150615199865	97993	80962
DL117	+38 468	+1144876	5027S	0	94421652	69185150481199894	97896	80845
DL118	+38 488	+1144883	5033S	0	92421689	69174150286199923	97729	80655
DL119	+38 510	+1144893	5041S	0	90421729	69159150142199955	97628	60524
DL120	+38 528	+1144911	5051S	0	90421762	69132150049199982	97602	60465
DL121	+38 548	+1144918	5060S	0	91421799	69121149979200011	97568	60421
DL122	+38 568	+1144932	5063S	0	95421835	69099149920200040	97528	60354
DL123	+38 586	+1144947	5075S	0	92421868	69077149651200060	97546	60329
DL124	+38 607	+1144957	5090S	0	92421907	69061149870200096	97576	60407
DL125	+38 629	+1144962	5101U	0	94421947	69053149922200130	97798	60494
DL126	+38 700	+1145232	5300Y	0	125422069	68055149396200234	99042	61091
DL127	+38 676	+1145134	5160Y	0	106422028	68799149778200196	98141	80648
DL128	+38 603	+1145241	5243Y	0	125421690	68046150020200091	99272	61514
DL129	+38 601	+1145151	5170Y	0	103421689	68778150065200088	98635	61104
DL130	+38 537	+1145168	5174Y	0	120421770	68756150257199995	98946	61421
DL131	+38 473	+1145212	5278Y	0	116421650	68694149693199902	99664	61779
DL132	+38 504	+1145112	5124Y	0	133421711	68839150577199947	98653	61509
DL133	+38 443	+1145141	5732Y	0	242421597	68799146975199657101065		61757
DL134	+38 415	+1145212	5297Y	0	120421543	68696149921199816	99956	62009
DL135	+38 342	+1145223	5248Y	0	126421407	68063150165199709	99845	82072
DL136	+38 263	+1145191	5166Y	0	124421262	68734150350199594	99563	61999
DL137	+38 310	+1145107	5120B	0	125421352	66054150770199663	99292	61954
DL138	+38 325	+1145018	5038C	0	101421383	68984150452199684	98681	61596
DL139	+38 350	+1144910	4965S	0	93421433	69141151038199721	98231	61321
DL140	+38 420	+1144943	5008Y	0	97421561	69090151205199823	98511	61527
DL141	+38 444	+1145021	5032C	0	112421503	68974151110199859	98607	61556
DL142	+38 495	+1144956	5037S	0	97421699	69067150666199934	98136	61053
DL143	+38 531	+1145026	5070S	0	98421764	68963150334199986	98062	60666
DL144	+38 619	+1145034	5087U	0	106421926	68946150251200115	98010	60766
DL145	+38 716	+1145057	51401T	0	105422105	68910149637200257	97953	60527
DL146	+38 685	+1145003	5113Y	0	102422049	68990150026200212	97934	60597
DL147	+38 738	+1144907	5191Y	0	94422151	69126149720200289	98264	60673
DL149	+38 575	+1144812	5058S	0	94421652	69274149741200051	97291	60134
DL150	+38 494	+1144769	5018S	0	97421704	69341149750199932	97043	60025
DL151	+38 445	+1144720	4993S	0	97421615	69415149601199660	96930	79997
DL152	+38 517	+1144664	5057C	0	98421750	69493149577199966	97003	79853
DL153	+38 597	+1144702	5092B	0	101421697	69434149325200083	97164	79897
DL154	+38 675	+1144675	51891T	0	102422042	69470149210200197	97762	80197
DL155	+38 735	+1144663	5248B	0	104422153	69465149172200284	98277	60482
DL156	+38 721	+1144760	5171Y	0	106422124	69344149720200264	98121	60590
DL157	+38 658	+1144783	51161T	0	96422007	69313149705200172	97674	60320
DL158	+38 692	+1144561	52529T	0	108422078	69630149314200222	98554	60725
DL159	+38 606	+1144592	5167B	0	101421917	69595149195200096	97727	60205
DL160	+38 526	+1144555	5115C	0	106421771	69655149352199979	97511	60171
DL161	+374502	+1143692	5539S	0	137418059	71010146507197022101492		62737
DL163	+374574	+1143726	5485S	0	123418191	70956146514197127101609		62424
DL165	+374617	+1143638	5495Y	0	149418273	71083146747197169101274		62661
DL166	+374679	+1143674	5416Y	0	164418387	71028147710197280101404		63094
DL167	+374677	+1143571	5558Y	0	152418387	71179146154197277101185		62581
DL168	+374665	+1143445	5759S	0	165418370	71364145519197259102377		62930
DL169	+374593	+1143417	6071S	0	220418232	71469143454197150103443		62457
DL170	+374517	+1143430	5962S	13	176418096	71355143754197044102624		62676
DL171	+374740	+1143458	5784Y	0	154418508	71342145406197369102533		62952
DL172	+374745	+1143518	5722Y	0	144418515	71254145725197376102205		62652
DL174	+374782	+1143562	5641S	0	155418581	71187145631197430101491		62406
DL176	+374786	+1143275	5507S	0	176419000	71608147091197436101403		62677
DL178	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM / EAST UTM	OBSV GRAV / THEO GRAV / FAA	CBA +1000
DL179	+374819+1143351	5657S	0	193418656	71495146298197484102055	82953
DL180	+374823+1143422	5763S	0	178418663	71391145624197490102370	82642
DL181	+374880+1143174	5433S	0	184418778	71752146531197573100090	81743
DL182	+374901+1143356	5918Y	0	235418809	71484144706197604102797	82649
DL183	+374899+1143476	5947Y	0	211418801	71308144286197601102657	82535
DL184	+374860+1143578	5631Y	0	184418725	71160144955197544102290	82557
DL187	+374939+1143289	5787Y	0	284418882	71580145474197659102284	82825
DL190	+374983+1143524	6228S	0	290418955	71233142648197723103728	82776
DL191	+375013+1143646	6067S	0	259419006	71053144002197767103336	82902
DL193	+375062+1143555	6473S	34	346419100	71184141449197639104535	82838
DL199	+375099+1143712	5904Y	0	297419162	70952145118197893102792	82952
DL200	+375114+1143734	5827Y	0	297419189	70919145046197915102572	82995
DL202	+375214+1143616	6513S	0	504419378	71087141131198061104372	82662
DL205	+38 9+1144375	4830S	0	127420821	69939150244199223 96477	80136
DL206	+38 48+1144470	4830S	0	117420690	69793150415199280 96591	80234
DL207	+38 78+11443804	6442T	0	144420948	69928150545199323 96612	80435
DL208	+38 123+1144454	4861Y	0	128421029	69516150413199389 96770	80318
DL209	+38 86+1144286	4940C	0	137420967	70065150268199335 97423	80711
DL210	+38 41+1144177	5160Y	0	152420887	70227149986199270 98713	81470
DL211	+38 19+1143951	5582Y	0	229420855	70559146621199238 99919	81109
DL212	+38 57+1143794	6296Y	0	433420931	70787142632199293102797	81756
DL213	+38 90+1143900	5758Y	0	275420988	70630145509199341100360	80996
DL214	+38 108+1144005	5445Y	0	207421017	70476147618199367 99495	81131
DL215	+38 81+1144090	5249Y	0	177420964	70352148954199328 99025	81299
DL216	+38 81+1144200	5075Y	0	155420960	70192150049199328 98482	81326
DL218	+38 148+1143827	6150Y	0	414421098	70734143127199426101583	81022
DL219	+38 150+1143918	5734S	0	262421098	70601145656199429100193	80698
DL220	+38 169+1144090	5370Y	0	186421127	70346148590199456 99672	81542
DL221	+38 169+1144200	5098Y	0	212421123	70187150227199456 98750	81575
DL222	+38 167+1144310	4861Y	0	170421115	70027150616199454 97697	80619
DL223	+38 172+11443864	6871T	0	133421122	69912150164199461 96694	80159
DL225	+38 199+1144460	4905C	0	117421169	69506150629199501 96689	80677
DL226	+38 260+11443054	9459T	0	120421284	69697149979199590 96936	80196
DL227	+38 279+1144408	4947C	0	117421316	69747149656199617 96805	80051
DL228	+38 237+1144273	4971Y	0	185421246	70078150650199556 97876	81107
DL229	+38 218+1144127	5836Y	0	275421216	70292145598199526100995	81365
DL230	+38 199+11440185	5020T	0	199421185	70452147064199501 99945	81373
DL231	+38 213+1143936	5756Y	0	237421214	70572145624199521100280	80665
DL232	+38 240+1143867	6008C	0	292421267	70671144182199560101168	80968
DL234	+38 302+1143892	5976Y	0	240421380	70632144493199651101086	80945
DL235	+38 289+1144000	5600Y	2	187421352	70475146009199632100446	81330
DL236	+38 273+1144074	5715Y	0	163421320	70367146576199609100754	81425
DL237	+38 276+1144181	5655Y	0	327421322	70210146960199613100569	81604
DL238	+38 297+1144306	5024Y	0	167421356	70027150370199644 99018	81139
DL239	+38 351+11444035	5020T	0	131421452	69982149654199723 97558	80367
DL240	+38 399+1144475	5055C	0	111421539	69775149537199793 97317	80197
DL241	+38 444+11444105	1010T	0	130421624	69568149770199859 97910	80641
DL242	+38 416+1144307	5451Y	0	175421576	70020148386199818 99669	81452
DL243	+38 350+1144242	5453Y	0	193421456	71110148574199721 99973	81567
DL244	+38 345+1144159	6216Y	0	168421450	70239143335199714102126	81597
DL245	+38 330+1143955	5826C	0	194421448	70541145720199720101 45	81568
DL246	+38 366+1144023	5733Y	0	150421494	70437146315199745100527	81152
DL247	+38 377+1144081	5889Y	0	163421512	70352145354199761100022	81100
DL248	+38 420+1144123	5506C	9	142421590	70289147409199823 99951	81124
DL249	+38 355+1143865	6114Y	0	253421480	70684143087199729101562	80912
DL251	+38 408+1143967	5653C	0	173421574	70517144992199806100272	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```
STATION  LAT.    LONG. ELEV. TER-COR. NORTH EAST  OBSV  THEO  FAA    CBA
IDENT. DEG MIN DEG MIN +CODE  IN/OUT  UTM   UTM  GRAV  GRAV         +1000

DL253   +38 412+1144195 6055Y    0 345421573 701841440019981210117 6 80869
DL254   +38 475+1144152 5465C    0 146421691 70244147624199904 99353 80459
DL255   +38 497+1144228 5454Y    0 122421729 70132148358199937 99751 81271
DL256   +38 491+1144335 5501Y    0 129421714 69978148152199927100004 81363
DL257   +38 465+1143790 6443Y    0 305421086 70773142023199890102775 81105
DL258   +38 448+1143900 6050Y    0 208421650 70613143952199865101026 80601
DL259   +38 468+1143975 5855Y    0 173421684 70503144932199894100143 80346
DL260   +38 515+1143875 6169Y   17 217421775 70647143565199963101663 80656
DL261   +38 538+1144004 5748Y    0 158421813 70457145595199996 99696 80245
DL262   +38 520+1144074 5589Y    0 138421777 70356146721199970 99351 80427
DL263   +38 531+1144142 5463Y    0 133421795 70256147621199986 99049 80550
DL265   +38 582+1143844 6343Y    0 281421900 70689142443200061102087 80734
DL266   +38 575+1143929 5856Y    0 187421584 70565145167200051100231 80445
DL269   +38 663+1143923 5892Y    0 174422047 70570144449200179 99723 79801
DL270   +38 740+1143524599111    0 184422193 70711144842200292100938 80636
DL271   +38 730+1143918582817    0 150422171 70574145069200277 99642 79915
DL272   +38 692+1144026 5604Y    0 141422097 70416146056200222 98576 79635
DL273   +38 664+1143990566607    0 149422066 70472145723200180 98868 79632
DL274   +38 627+1144062556007    0 135421975 70366146718200127 98921 80492
DL275   +38 593+1144025 5628Y    0 145421914 70424146515200077 99204 80154
DL276   +38 711+1144121 5622Y    0 121422128 70276146583200249 99614 80196
DL278   +38 602+1144175540621    0 129421925 70204147917200090 98703 80394
DL282   +38 564+1144274528807    0 136421851 70061149563200034 99295 81595
DL285   +38 562+1144356 52588   20 124421644 69941149759200031 99207 81418
DL286   +38 546+1144382 52218    0 153421614 69904149963200008 99110 81456
DL287   +38 531+1144405 51708    0 128421785 69871150032199986 98892 81316
DL288   +38 516+1144435 51618    0 122421756 69826149722199964 98329 80646
DL289   +38 504+1144458 51408    0 116421733 69795149613199947 98040 80625
DL290   +38 492+1144482 51168    0 116421710 69760149465199929 97663 80350
DL291   +38 560+1144455 51718    0 138421837 69797149962200029 98599 81100
DL292   +38 613+1144291 5602Y    0 113421941 70034147047200106 99664 80670
DL293   +38 628+1144381 5736Y   94 146421966 69902146579200128102435 81111
DL294   +38 623+1144491 5250C    0 121421952 69741149622200121 99914 81129
DL295   +38 705+1144435539307    0 124422106 69822146596200241 99110 80541
DL296   +38 710+1144326552307    0 130422119 69987147465200248 99216 80534
DL297   +38 687+1144237550007    1 122422080 70110147256200214 98806 80170
DL298   +373818+1144437 5693S  157 260416767 69946144533196024102089 83089
DL299   +373793+1144314 5845S   81 262416725 70128143465195986102489 82696
DL300   +373808+1144186 6147S  166 355416757 70316141894196004102740 83235
DL301   +373802+1144078 6229S    0 252416750 70475141455196001104081 83087
DL302   +373778+1143971 5905Y    0 171416709 70635143122195966102732 82753
DL303   +373781+1143849 5923S    0 166416719 70813143281195970103057 83021
DL304   +373818+1143790 5874S    0 164416790 70886143155196024102413 82542
DL305   +373904+1143789 5825S    0 153416909 70095143114196 1  101766 82376
DL306   +373849+1143900 5922Y    0 164415843 70731143516196070103251 83195
DL307   +373846+1143978 6072S    0 199416635 70620142557196065103421 82901
DL308   +373838+1144259 5707S    0 204416810 70207144673196055102332 83371
DL309   +373888+1144422 5928S    0 776416897 69965142604196127102526 83363
DL310   +373869+1144343 5618S    0 298416664 70082145540196098102120 83250
DL311   +373921+1144359 51807    0 160416960 70056148357196174100925 83416
DL312   +373959+1144406 50707    0 155417028 69982148876196238100363 83226
DL313   +373982+1144312 5262S    0 159417074 70122148157196263100851 83211
DL314   +373916+1144264 5598S    0 210416954 70196145641196167101436 83606
DL315   +373900+1144190 5890S    0 285416927 70306143554196144102845 83 41
DL316   +373884+1144077 6598S    0 570416902 70472136721196120104772 82836
DL317   +373917+1144015 5904S    0103116965 70562136522196169  5337 82 2
DL318   +373927+1143806 6053   0 19 416980 707 [illegible]
```

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL319	+373984+1143763	5744Y	0	141417098	70930143106196266100960	81510
DL320	+374000+1143840	5801S	5	144417125	70807143175196290101482	81846
DL321	+374020+1143955	5902S	0	160417158	70640143052196319102281	82311
DL322	+373993+1144034	6207S	0	283417105	70531141568196280103729	82841
DL323	+373962+1144101	6376S	0	384417045	70434140518196234104306	82944
DL324	+373994+1144188	5352S	174	541417101	70304139967196280103492	82542
DL325	+374036+1144395	5418S	0	251417171	69960146562196342101211	82983
DL326	+374059+1144246	5278Y	0	172417219	70216147769196376101086	83256
DL327	+374078+1144160	5600S	0	223417257	70342145237196403102103	83022
DL328	+374038+1144066	6138S	0	293417187	70482141744196345103169	82527
DL329	+374071+1143644	5798S	0	135417256	70806143511196393101486	81845
DL330	+374102+1143930	5801Y	0	142417310	70679143407196438101566	81922
DL331	+374166+1143755	5725S	0	129417435	70933144332196531101682	82284
DL332	+374180+1143888	5778S	0	134417456	70737143709196552101537	81964
DL333	+374110+1144073	6026S	0	293417320	70466142512196450102779	82519
DL334	+374114+1144253	5221S	0	150417321	70203148182196455100663	83295
DL335	+374095+1144359	5559S	0	431417282	70046145581196420101472	82942
DL336	+374169+1144493	4773Y	0	121417414	69848149836196536 98221	82062
DL337	+374176+1144471	4800S	0	121417427	69880149902196540 98527	82270
DL338	+374165+1144447	4849Y	0	122417408	69916149925196530 99029	82612
DL339	+374156+1144422	4898Y	0	134417392	69953149909196517 99487	82915
DL340	+374147+1144397	4942Y	0	134417376	69990149744196504 99750	83028
DL341	+374137+1144374	4985Y	0	139417359	70024149492196489 99917	83054
DL342	+374132+1144345	5035S	0	138417351	70067149244196482100147	83112
DL343	+374181+1144278	5138S	0	138417444	70163148612196553100613	83227
DL344	+374154+1144161	5388Y	0	158417398	70537147154196514101348	83139
DL345	+374202+1144126	5551Y	0	178417488	70383146206196584101065	83110
DL346	+374180+1144053	6103S	0	395417450	70494141038196552102727	82306
DL347	+374172+1143999	5889S	0	172417437	70574143293196541102178	82204
DL348	+374242+1143708	5764Y	0	131417574	70860144253196642101865	82536
DL349	+374242+1143805	5712S	0	132417570	70724144516196642101614	82271
DL350	+374256+1144432	4902S	0	135417577	69934150253196663 98782	82539
DL351	+374237+1144376	4959S	0	141417544	70017149779196635 99814	83041
DL352	+374226+1144217	5659S	0	247417533	70251145565196622102136	83115
DL353	+374265+1144224	6014S	0	656417601	70239142751196676102077	82821
DL354	+374265+1144136	6298S	0	736417604	70365140823196676103423	82679
DL355	+374251+1144063	6001S	59	234417581	70476142674196655102696	82524
DL356	+374256+1143998	5970S	39	205417592	70572142802196663102327	82209
DL357	+374301+1143933	5798S	0	164417678	70665144126196726101966	82555
DL358	+374307+1143826	5770S	0	148417693	70822144556196738102114	82545
DL359	+374381+1143759	5695S	0	131417832	70917145607196845101761	82466
DL360	+374473+1143779	5456Y	0	126418002	70883146361196979100750	82257
DL361	+374441+1143632	5431Y	0	134417941	70807146036196933100817	82427
DL362	+374370+1143909	5673S	0	138417807	70697144991196629101554	82543
DL363	+374458+1143955	5601S	0	139417968	70625140656196957102412	[illegible]
DL364	+374415+1143944	5505S	0	125417887	70585140600196895101440	82624
DL365	+374325+1143972	5700S	0	138417721	70607144937196763101819	82516
DL366	+374325+1144061	5990S	70	272417718	70476142000196763102498	82579
DL367	+374370+1144054	5785S	82	229417809	70484144592196835102263	82774
DL368	+374402+1144099	5457S	0	132417933	70015147172196934101408	82976
DL369	+374491+1144131	5966S	0	521418022	70365143191197005102356	82504
DL370	+374401+1144179	5219Y	0	150417554	70312148607196874100650	83149
DL371	+374323+1144168	6110S	0	574417710	70319142295196760103042	82676
DL372	+374324+1144267	5208S	0	159417708	70173148451196762100703	[illegible]
DL373	+374289+1144319	5879S	158	649417642	70096143464196711102162	82625
DL374	+374345+1144389	4771Y	0	112417743	69993150480196792 99466	82566
DL375	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM EAST UTM OBSV GRAV THEO GRAV		FAA	CBA +1000
DL376	+374345+1144497	4609S	0	112417739	698341500650196792	97232	81624
DL378	+374459+1144446	4650S	0	109417952	699011509970196959	97772	82021
DL379	+374437+1144341	4855S	2	129417915	700591505580196927	99322	82494
DL380	+374480+1144255	5500S	0	286417997	701841464041969901	01236	82765
DL381	+374401+1144259	5025Y	0	168417351	701811496891968741	00106	83135
DL384	+373763+1143716	5700S	0	155416671	710091433821959441	01084	81796
DL385	+373871+1143654	5728S	0	161416893	710951426941961021	00702	81327
DL386	+374002+1143635	5681Y	0	132417134	710431434401962921	00611	81367
DL387	+374007+1143574	5355B	0	151417148	712061459241963001	00022	81919
DL388	+373960+1143486	5223S	0	176417054	71335146738196231	99661	82022
DL389	+373904+1143370	5250S	0	132416965	71511140591196149	99651	82076
DL393	+373984+1143357	5494S	0	156417113	715271451761962661	00619	82036
DL394	+374027+1143428	5577D	0	155417190	714201447241963291	00681	82014
DL395	+374073+1143516	5642Y	0	156417272	712891453901963961	02094	83096
DL396	+374108+1143463	5843S	0	186417339	713651435981964471	02143	82400
DL397	+374068+1143634	5560B	0	134417258	711151449071963861	00646	82016
DL398	+374083+1143736	5703B	0	128417282	709651437461964101	01010	81657
DL399	+374149+1143681	5687B	0	135417406	710121444191965071	01436	82174
DL400	+374148+1143610	5667B	0	147417407	711351445751965051	01406	82226
DL401	+374214+1143698	5767B	0	138417526	710141447441966021	02419	82666
DL402	+374267+1143729	5784S	0	136417623	709661445831960791	02341	82749
DL403	+374245+1143620	5670S	0	159417586	711271444921966471	03092	83256
DL404	+374236+1143561	6055S	12	198417572	712151430471966341	03402	82960
DL408	+374095+1143373	5820S	0	204417318	714981437871964281	02135	82486
DL411	+374157+1143529	5836B	0	179417427	712651438741965191	02283	82557
DL412	+374191+1143632	5802S	0	155417486	711121446321965681	02069	82435
DL413	+374332+1143679	5883S	0	174417745	710371445101967731	03105	83214
DL414	+374361+1143605	5853S	0	161417801	711441444061968161	02078	82676
DL415	+374410+1143668	6039S	0	264417889	710491435761968861	03330	82997
DL416	+374486+1143587	5838S	0	156417959	711661444371969401	02443	82687
DL417	+374491+1143409	5865S	0	163418046	712941439951970051	02378	82468
DL418	+374402+1143521	6122S	0	225417660	712651425071968761	03251	82596
DL422	+373729+1144435	6002S	111	366416602	699531424161958951	03013	83019
DL423	+373717+1144197	5865S	0	195416590	703771435571956771	02878	83001
DL424	+373724+1144049	6026Y	0	179416607	705211423841956881	03213	82637
DL425	+375290+1145506	5829S	0	227419434	665141452351981571	01938	82284
DL426	+375257+1145305	5422S	0	172419398	666091471541981231	00059	81736
DL427	+375296+1145382	6061S	0	622419468	664951427151981801	01569	81519
DL428	+375345+1145288	5113S	0	142419561	666301197251982 52	99591	82297
DL429	+375384+1145392	5712S	0	224419630	668761459651983091	01415	82157
DL430	+375401+1145298	5094Y	0	161419065	666131499561983 34	99572	82359
DL431	+375324+1145488	5835S	0	270419516	683361454151982211	02110	82475
DL432	+375382+1145477	5915S	0	263419624	663521447721985301	02136	82225
DL433	+375436+1145272	5001Y	0	116419730	665601510791983 85	99501	82291
DL434	+375451+1145296	5134Y	0	121419757	666141497611984 07	99671	82281
DL435	+375456+1145320	5175Y	0	118419769	665791495711984 17	99856	82324
DL436	+375468+1145344	5193Y	0	123419787	665431495751984321	00015	82426
DL437	+375477+1145370	5224Y	0	144419803	665051495661984451	00227	82553
DL438	+375485+1145396	5257Y	0	122419817	664661493691984571	00388	82586
DL439	+375487+1145421	5299Y	0	114419819	664251490661984591	00477	82547
DL440	+375480+1145456	5355Y	0	144419806	663871486661984491	00631	82597
DL441	+375485+1145477	5421Y	0	153419810	663481481471984541	00713	82376
DL442	+375490+1145503	5423Y	0	144419822	663091481011984661	00675	82325
DL443	+375514+1145340	5142Y	0	125419860	665471500641985 05	99971	82558
DL444	+375600+1145321	5245S	0	123420032	665711494921986251	00229	82465
DL445	+375550+1145411	5536S	0	125419992	664401475961985951	01105	82517
[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA / BGA +1000
DL453	+375312+1145229	51730	50	115419502	68718149609198204100089	82611
DL454	+375295+1145110	47960	0	109419475	68693151795196179 96750	82502
DL455	+375303+1145144	48770	0	108419599	68641151361196276 99000	82474
DL456	+375303+1145024	47540	0	95419493	69019151309198191 97856	81736
DL457	+375350+1144925	47205	0	87419583	69162151194198259 97356	81342
DL458	+375262+1144923	46755	0	88419420	69169151469198131 97354	81496
DL459	+375313+1144836	46475	0	88419517	69294150963198205 96520	80750
DL460	+375260+1144065	46245	0	90419425	69547149753198128 95180	79459
DL461	+375308+1144006	46360	0	95419516	69632149735198196 95166	79449
DL462	+375310+1144515	46330	0	110419523	69764149606198201 95205	79513
DL463	+375388+1145023	48110	0	95419650	69017150947198315 97908	81594
DL464	+375426+1145250	50385	1	116419712	68683150422198370 99464	82396
DL465	+375419+1145223	49935	0	116419700	68723150916198360 99545	82631
DL466	+375416+1145197	49630	0	111419696	68761151190198356 99536	82719
DL467	+375432+1145174	49545	0	111419726	68794151136198379 99379	82595
DL468	+375447+1145151	49395	0	108419755	68827151217198401 99297	82559
DL469	+375464+1145135	49530	0	108419787	68850151239198426 99426	82649
DL470	+375464+1145097	48965	0	110419788	68905151501198426 99151	82562
DL471	+375455+1145068	48605	0	103419772	68946151479198413 98603	82331
DL472	+375452+1145040	48365	0	105419768	68989151194198409 98297	81907
DL473	+375446+1145012	401207	0	98419757	69031151150198400 97940	81625
DL474	+375445+1144986	47845	0	95419756	69069151097198390 97720	81498
DL475	+375441+1144956	47585	0	92419750	69113151225198392 97610	81474
DL476	+375438+1144929	47425	0	90419745	69153151290198388 97529	81445
DL477	+375435+1144906	472601	0	89419741	69186151331198384 97442	81405
DL478	+375431+1144876	47115	0	86419734	69226151314198378 97271	81291
DL479	+375428+1144851	46975	0	88419730	69267151235198373 97064	81132
DL480	+375424+1144824	46765	0	89419723	69307151144198367 96781	80922
DL481	+375422+1144798	466401	0	89419720	69345151034198365 96562	80745
DL482	+375419+1144770	46555	0	90419716	69386150660198360 96307	80520
DL483	+375414+1144718	46489T	0	91419708	69463150346198353 95750	79964
DL484	+375409+1144690	46455	0	95419700	69504150140198345 95508	79760
DL485	+375407+1144066	46145	0	93419697	69539149976198343 95337	79590
DL486	+375404+1144638	46485	0	95419693	69581149763198338 95166	79420
DL487	+375309+1144608	46499T	0	96419684	69625149652198331 95081	79316
DL488	+375396+1144574	46505	0	102419680	69675149562198327 94995	79237
DL489	+375394+1144553	46495	0	102419677	69706149541198323 94968	79213
DL490	+375392+1144530	46495	0	104419674	69739149543198321 94973	79221
DL491	+375386+1144501	46489T	0	113419664	69782149577198312 95016	79272
DL492	+375378+1144500	46480	0	110419649	69775149596198300 95036	79296
DL493	+375545+1144526	46605	0	106419957	69735149416198545 94916	79060
DL494	+375461+1144594	46630	0	98419800	69642149326198426 94867	79081
DL495	+375266+1144762	46215	0	88419433	69405151163198137 95513	79841
DL496	+375288+1144755	46235	0	89419470	69414150213198169 95550	79672
DL497	+375307+1144749	46255	0	89419500	69426150254198197 95583	79897
DL498	+375329+1144743	46305	0	89419550	69430150292198229 95036	79935
DL499	+375350+1144736	46335	0	90419589	69439150315198259 95665	79950
DL500	+375372+1144730	46405	0	90419630	69447150336198291 95710	79974
DL501	+375392+1144724	46455	0	90419667	69455150344198321 95737	79984
DL502	+375430+1144705	46525	0	92419746	69481150210198352 95645	79970
DL503	+375453+1144695	46545	0	91419781	69495150100198410 95566	79789
DL504	+375473+1144084	46585	0	94419819	69510150107198439 95573	79715
DL505	+375493+1144073	46605	0	96419856	69525150062198469 95448	79659
DL506	+375512+1144063	46695	0	93419892	69539150204198496 95407	79615
DL507	+375531+1144052	46745	0	94419927	69554149961198524 95424	79576
DL508	+375553+1144041	46795	0	96419966	69570149994198556 95371	79559
DL509	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	F.A.	CBA +1000
DL510	+375593+1144620	4690S	0	99420043	69599149791198615	95314	79417
DL511	+375612+1144610	4699S	0	98420078	69612149708198642	95287	79356
DL512	+375633+1144599	4705S	0	98420118	69628149649198673	95255	79305
DL513	+375652+1144589	4716S	0	99420153	69641149562198701	95187	79221
DL514	+375672+1144579	4715S	0	101420190	69655149534198730	95176	79196
DL515	+375692+1144568	4717S	0	103420228	69670149529198759	95161	79175
DL516	+375711+1144558	4720S	0	105420263	69684149509198787	95141	79146
DL517	+375731+1144547	4732S	0	103420301	69699149466198816	95182	79146
DL518	+375752+1144536	4742S	0	104420340	69715149415198847	95195	79125
DL519	+375771+1144526	4741S	0	106420375	69728149449198875	95191	79127
DL520	+375791+1144515	4745S	0	108420413	69744149469198904	95220	79144
DL521	+375811+1144505	4753S	0	109420450	69757149475198933	95272	79170
DL522	+375912+1144516	4765S	0	109420637	69737149893199080	95844	79632
DL523	+375941+1144530	4798S	0	107420690	69715150065199123	96095	79838
DL524	+375965+1144547	4810S	0	107420739	69689150205199163	96309	80010
DL525	+375901+1144542	4799S	0	104420615	69699149692199065	95906	79672
DL527	+375918+1144594	4801S	0	100420645	69622150157199090	96249	79974
DL528	+375910+1144568	4795S	0	102420631	69661150025199070	96073	79821
DL529	+375927+1144620	4804S	0	100420661	69584150237199102	96344	80059
DL530	+375936+1144646	4808S	0	102420676	69546150271199116	96403	80106
DL531	+375945+1144672	4813S	0	97420692	69507150275199129	96441	80122
DL532	+375952+1144696	4816S	0	97420704	69471150322199139	96506	80177
DL533	+375961+1144723	4822S	0	96420720	69431150387199152	96614	80264
DL534	+375969+1144748	4826S	0	102420734	69395150505199164	96758	80400
DL535	+375979+1144774	4831S	0	97420751	69356150745199179	97030	80650
DL536	+375987+1144799	4835S	0	100420765	69319151054199191	97356	80975
DL537	+375996+1144826	4830S	0	108420781	69279151370199204	97706	81311
DL538	+375940+1144879	4824S	0	105420676	69204151605199122	98082	81735
DL539	+375932+1144770	4815S	0	98420665	69364150597199116	96090	80476
DL540	+375878+1144873	4805S	0	103420561	69210151558199031	97746	81401
DL541	+375846+1144779	4766S	0	93420505	69355150528198984	96584	81354
DL542	+375880+1144688	4793S	0	95420571	69486150292199034	96365	80112
DL543	+375820+1144617	4771U	0	96420463	69593149693198946	95846	79670
DL544	+375795+1144085	4762S	0	93420414	69494150144198909	96049	79901
DL545	+375772+1144767	4766S	0	92420369	69375150434198876	96404	80261
DL546	+375801+1144869	4762S	0	98420419	69225151571198919	97456	81244
DL547	+375727+1144879	4771S	0	96420282	69213151277198810	97386	81209
DL548	+375724+1144613	4733U	0	95420298	69559149662198806	95597	7955
DL549	+375681+1144775	4732S	0	92420200	69368150716198743	96499	80452
DL550	+375642+1144871	4729U	0	98420125	69229151302198686	97320	81209
DL551	+375636+1144693	4711U	0	93420120	69504150161198677	95818	79843
DL552	+375609+1144809	4711U	0	92420066	69321151093198636	96790	80814
DL553	+375586+1144908	4711S	0	101420020	69177151597198604	97326	81391
DL554	+375531+1144757	4687U	0	90419923	69401150631198524	96416	80526
DL555	+375520+1144886	4767U	0	89419916	69215151407198516	97564	81462
DL556	+375476+1144794	4675S	0	91419824	69349151281198446	96790	80936
DL557	+375502+1145005	4738S	0	107419861	69035151404198481	97981	81759
DL558	+375562+1144993	4734S	0	136419973	69053151801198570	97762	81772
DL559	+375621+1144985	4758S	0	138420082	69063151815198655	97937	81810
DL560	+375702+1144989	4859U	0	127420232	69065151462198773	98422	81477
DL561	+375740+1144985	4842U	0	112420313	69057151312198838	98614	81577
DL562	+375981+1145030	5019U	0	113420746	68981150487199181	98544	81534
DL563	+375906+1144977	4909U	0	109420609	69062151194199072	98321	81665
DL564	+375818+1144973	4861U	0	109420447	69064151516198943	98496	81959
DL566	+375970+1145162	5332S	0	153420721	68784148944199166	99959	81926
DL567	+375997+1145003	5070U	0	127420607	68697151395199075	99029	81867
DL568	+3759[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. LONG. DEG MIN DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL569	+375820+1145097	50640	0	120420446	66890150108198946	99008	81788
DL570	+375778+1145189	52455	0	132420365	68757149356196085	99833	82076
DL571	+375760+1145088	50590	0	115420336	68906150291198659	98959	81949
DL572	+375704+1145047	54360	0	241420233	68968147919198777100302		82003
DL573	+375722+1145231	52715	0	163420260	68696149196198603100001		82184
DL574	+375686+1145132	52515	0	112420197	68645149034198750	99702	81904
DL575	+375650+1145249	52105	11	124420127	68675149723198698100057		82422
DL576	+375620+1145080	58120	228	563420077	68924145114196654101161		82129
DL577	+375600+1145164	56950	0	287420037	68601145960198625100940		81805
DL578	+375542+1145244	50785	0	130419927	68687150235198540	99485	82295
DL579	+375529+1145196	52540	0	108419905	68757148439198521	99365	81553
DL580	+375525+1145076	50790	0	132419901	68935149701198515	98985	81794
DL582	+374570+1144778	45800	0	85418145	69412149339197121	95319	79783
DL583	+374578+1144596	46010	0	88418166	69079149595197133	95762	80157
DL584	+374616+1144698	45825	0	85418233	69527149513197186	95466	79903
DL585	+374653+1144604	45790	0	85418298	69370149301197242	95151	79610
DL586	+374500+1144061	45805	0	92418013	69293149458197019	95555	80026
DL587	+374522+1144065	45605	0	91418056	69286149511197051	95561	80031
DL588	+374543+1144070	45605	0	92418092	69278149541197081	95561	80032
DL589	+374563+1144874	45815	0	90418129	69271149556197111	95556	80022
DL590	+374585+1144879	45605	0	89418170	69265149616197145	95574	80042
DL591	+374609+1144682	45805	0	89418214	69257149657197177	95561	80049
DL592	+374627+1144889	45805	0	90418247	69246149721197204	95619	80068
DL593	+374646+1144894	45805	0	89418286	69238149508197234	95675	80143
DL594	+374669+1144896	45605	0	89418324	69231149865197265	95723	80191
DL595	+374691+1144902	45605	0	89418365	69224149669197296	95693	80161
DL596	+374712+1144917	45815	0	91418403	69202150171197326	95990	80465
DL597	+374734+1144910	45615	0	90418444	69211150163197360	95914	80383
DL598	+374755+1144904	45835	0	89418463	69219150157197391	95896	80354
DL599	+374775+1144699	45835	0	88418520	69225150159197420	95869	80325
DL600	+374797+1144093	45525	0	88418561	69235150147197452	95615	80275
DL601	+374816+1144887	45635	0	87418600	69241150179197483	95821	80277
DL602	+374841+1144881	45845	0	87418643	69249150205197510	95826	80250
DL603	+374861+1144875	45555	0	87418686	69257150226197545	95834	80242
DL604	+374883+1144869	45885	0	86418721	69265150208197577	95808	80245
DL605	+374907+1144869	45665	0	87418765	69264150366197613	95911	80357
DL606	+374933+1144856	45675	0	86418814	69281150255197651	95752	80193
DL607	+374955+1144850	45875	0	86418855	69289150160197685	95645	80086
DL608	+374976+1144844	45873	0	86418894	69297150236197715	95692	80133
DL609	+374998+1144836	45895	0	87418935	69305150227197745	95666	80105
DL610	+375019+1144832	45935	0	84418974	69313150285197776	95734	80152
DL611	+375040+1144826	45965	0	84419024	69321150196197616	95633	80041
DL612	+375068+1144820	45983	0	85419065	69326150094197646	95517	79921
DL613	+375089+1144813	46015	0	85419104	69336149955197676	95376	79766
DL614	+375111+1144809	46035	0	85419145	69343149915197910	95362	79706
DL615	+375133+1144802	46055	0	85419186	69352149920197942	95314	79692
DL616	+375157+1144798	46185	0	86419230	69363149946197977	95335	79704
DL617	+375178+1144789	46115	0	86419269	69369149979198009	95364	79723
DL618	+375200+1144785	46165	0	86419310	69377150055198041	95416	79765
DL619	+375222+1144775	46175	0	86419351	69386150075198073	[illegible]	[illegible]
DL620	+375246+1144769	46165	0	87419396	69395150121198100	95471	[illegible]
DL621	+375231+1144531	46265	0	100419376	69745149947198066	95536	79755
DL622	+375204+1144695	46290	0	92419324	69636149717198046	95148	79183
DL623	+375176+1144696	46100	0	87419269	69520149556198005	94966	79316
DL624	+375003+1144750	45960	0	83418987	69434149439197752	94938	79345
DL625	+374989+1144649	45970	0	87418925	69353149433197732	94982	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL627	+375063+1144591	4606S	0	90419064	696651498121978841	95317	79696
DL628	+375080+1144702	4606S	0	85419091	695011493791978865	94060	79236
DL629	+375133+1144604	4613U	0	90419193	69642149724197942	95194	79550
DL630	+374946+1144789	4591S	0	85418840	69379149579197670	95115	79541
DL631	+374908+1144629	4591S	0	87418776	69615149433197614	95024	79452
DL632	+374914+1144522	4612S	0	93418791	69772150201197623	95981	80345
DL633	+374891+1144736	4593U	0	84418740	69459149186197589	94820	79239
DL634	+374827+1144792	4562S	0	84418620	69380149387197496	95012	79406
DL635	+374778+1144722	4562S	0	84418532	69485149210197424	94926	79302
DL636	+374760+1144813	4560U	0	85418496	69352149427197398	95131	79594
DL637	+374751+1144654	4564S	0	86418484	69586149206197385	95158	79609
DL638	+374829+1144637	4566S	0	86418629	69607149400197498	95059	79503
DL639	+374829+1144524	4605S	0	92418633	69773150000197498	95838	80224
DL640	+374747+1144565	4602S	0	89418480	69717149617197379	95546	79939
DL641	+374709+1144891	4580S	0	88418379	69240149896197323	95074	79141
DL642	+374706+1144863	4580S	0	87418394	69281149642197320	95425	79691
DL643	+374703+1144836	4580S	0	85418389	69321149417197315	95206	79670
DL644	+374700+1144809	4580S	0	85418385	69361149505197310	95096	79560
DL645	+374696+1144781	4580S	0	84418378	69402149279197305	95076	79539
DL646	+374693+1144755	4580S	0	84418374	69440149310197300	95113	79576
DL647	+374690+1144729	4580S	0	85418369	69478149341197296	95147	79611
DL648	+374687+1144702	4582U	0	85418364	69516149396197291	95227	79684
DL649	+374684+1144675	4583S	0	85418360	69556149453197288	95295	79749
DL650	+374681+1144640	4585S	0	86418355	69598149519197283	95385	79835
DL651	+374678+1144620	4590S	0	86418351	69639149568197278	95485	79916
DL652	+374674+1144593	4597S	0	87418344	69679149627197273	95616	80024
DL653	+374671+1144566	4605S	0	88418340	69719149676197268	95746	80126
DL654	+374668+1144539	4613S	0	89418335	69756149771197264	95919	80274
DL655	+374664+1144512	4633S	0	90418328	69798149626197258	96169	80457
DL656	+374548+1144991	4654U	0	97418097	69100150213197089	96922	81146
DL657	+374640+1144980	4628U	0	94418268	69112150015197223	96946	81255
DL658	+374727+1144968	4610U	0	93418429	69126150776197350	96608	81177
DL659	+374813+1144972	4616U	0	92418588	69116151026197475	96991	81539
DL660	+374899+1144983	4640U	0	92418747	69097151452197601	97517	81784
DL661	+374986+1144995	4602U	0	92418907	69075151539197728	97080	81875
DL662	+375072+1145007	4683U	0	92419066	69054151728197853	97945	82065
DL663	+375130+1145014	4691U	0	94419173	69041151742197936	97950	82045
DL664	+375215+1145018	4707U	0	95419330	69032151539198063	97792	81820
DL665	+375199+1144895	4645S	0	87419305	69213151656198039	97521	81565
DL666	+375130+1144910	4635U	0	88419176	69155151496197936	97179	81459
DL667	+375064+1144911	4622U	0	87419054	69195151394197841	97049	81372
DL668	+374978+1144910	4603S	0	88418895	69200151192197716	96791	81162
DL669	+374519+1145093	4760S	0	103418040	68951150626197046	98069	81937
DL670	+374590+1145151	4833U	0	109418170	68865150129197150	96357	81962
DL671	+374639+1145051	4691U	0	104418264	69008150903197221	97526	81932
DL672	+374672+1145107	4748S	0	108418323	68924150658197270	96281	82195
DL673	+374683+1145219	5072U	0	137418339	68759148825197680	99372	82210
DL674	+374735+1145168	4765S	0	125418437	68832150954197362	98435	82308
DL675	+374782+1145217	4835S	0	131418522	68756150632197430	99364	81944
DL676	+374868+1145236	4841U	0	131418674	68727151591197559	99870	82320
DL677	+374809+1145092	4702U	0	106418560	68941151640197456	98634	82113
DL678	+374754+1145075	4679U	0	108419475	68966151182197389	97626	81976
DL679	+374885+1145040	4678U	0	100418719	69014151295197580	97738	81653
DL680	+374875+1145164	4865U	5	110418696	68832150704197566	98358	82064
DL682	+374953+1145104	4702S	0	101418043	68917150780197686	97915	81775
DL683	+371980+1145216	4895S	0	109419889	68760151404197720	98497	81919
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION LAT. LONG. ELEV. TER-COR. NORTH EAST OBSV THEO FAA CBA
IDENT. DEG MIN DEG MIN +CODE IN/OUT UTM UTM GRAV GRAV +1000

DL685	+375050+1145147	4817S	0	102419020	68650150550197621	98061	81733
DL686	+375139+1145165	4848L	0	108419184	68619150729197952	98462	81975
DL687	+375207+1145116	4862S	0	109419312	68688151221198051	98362	82093
DL688	+375245+1145199	4910S	0	117419379	68765150765198106	98867	82237
DL690	+375266+1144454	4623Y	0	116419444	69856150439198137	95509	80157
DL691	+375250+1144534	4746C	0	116419419	70133150756198113	97459	81399
DL692	+375319+1144407	4657C	0	120419544	69923150536198214	96148	80384
DL693	+375385+1144474	4647C	0	113419063	69822149656198311	95077	79349
DL694	+375381+1144445	4647C	0	120419057	59864149626198305	95248	79516
DL695	+375376+1144419	4651 9T	0	125419649	69903150497198298	95579	79636
DL696	+375379+1144387	4682C	0	123419055	69950150460198302	9622[illegible]	80374
DL697	+375380+1144357	4710C	0	124419058	69993150771198303	96793	80652
DL698	+375380+1144322	4746 1T	0	128419059	70045151003198303	97364	81304
DL699	+375361+1144303	4772C	0	128419025	70073151042198276	97575	81526
DL700	+375335+1144293	4789Y	0	127419577	70089151059198236	97890	81665
DL701	+375331+1144260	4834Y	0	132419571	70129151013198232	98274	81913
DL702	+375325+1144240	4873Y	0	136419557	70166150771198220	98411	81926
DL703	+375313+1144215	4921Y	0	140419539	70205150481198205	98587	[illegible]945
DL704	+375305+1144188	4974Y	0	147419526	70245150864198194	98681	81663
DL705	+375299+1144162	5024Y	0	151419515	70283149629198185	98925	81941
DL706	+375292+1144135	5075Y	0	160419503	70323149585198175	99173	82024
DL707	+375284+1144109	5126Y	0	165419490	70361149435198163	99514	82195
DL708	+375274+1144083	5177Y	0	175419472	70400149313198148	99887	82404
DL709	+375264+1144063	5219Y	9	162419454	70430149236198134	100220	82590
DL710	+375255+1144037	5265C	0	167419439	70468148904198121	100394	82605
DL711	+375284+1143942	5462C	0	240419496	70606147774198163	10101[illegible]	82520
DL712	+375313+1143836	5769Y	0	272419553	70757145713198205	101991	82510
DL713	+375270+1143768	5972Y	0	327419476	70862144475198143	102540	82[illegible]96
DL714	+375372+1143767	6107Y	0	350419065	70859143913198291	103100	82620
DL715	+375381+1143958	5596Y	0	216419075	70576140052198305	101156	82538
DL716	+375381+1143880	5806Y	0	254419677	70693145446198305	101785	82237
DL719	+375307+1144134	5040Y	0	192419005	70322150175198255	99351	82353
DL720	+375404+1144146	5063Y	0	197419710	70302150048198336	99358	82287
DL721	+375370+1144217	4890Y	0	153419045	70193150052198289	98383	81658
DL722	+375440+1144052	5315C	36	216419780	70438148544198391	100274	82596
DL723	+375462+1143939	5829Y	0	227419825	70602145247198423	101064	82033
DL725	+375496+1143810	6216Y	0	286419692	70781143047198473	103078	82105
DL726	+375523+1143910	5174Y	0	296419939	70630142606198513	102405	81645
DL735	+375730+1143881	5722Y	0	269420323	70675140665198815	101069	82398
DL736	+375732+1143953	5560C	0	253420324	70569147631198618	100591	81662
DL739	+375776+1143760	6059C	0	314420412	70681144731198882	102175	81623
DL740	+375795+1143876	5775Y	0	240420441	70679145491198909	101935	81476
DL741	+375807+1143999	5442Y	0	217420461	70496147616199271	101103	81749
DL742	+375775+1144131	5220Y	0	197420398	70355149324198880	09957[illegible]	81365
DL743	+375834+1144109	5879Y	0	021420507	70345144221198961	00[illegible]	81555
DL744	+375881+1144125	5109Y	0	181420593	70513149263199035	98013	81394
DL745	+375896+1144041	5308Y	0	184420624	70433148137199057	99335	81414
DL746	+375915+1143995	5584C	0	229420063	70575140051199085	100082	81265
DL747	+375874+1143916	5545 0T	0	243420588	70617146505199025	100[illegible]	81257
DL749	+375964+1143841	5979Y	0	247420757	70722148259199157	[illegible]	81264
DL750	+375991+114[illegible]084	5269	[illegible]	135420799	70009146215199136	98786	8[illegible]031
DL751	+375946+114[illegible]113	51[illegible]19	0	159420713	70[illegible]11495761[illegible]9130	98253	81[illegible]14
DL752	+375994+1144239	4963Y	0	102420798	70138149972199201	97409	80624
DL753	+375994+1144240	4962Y	0	139420724	70139149756199142	9735[illegible]	80525
DL754	+375906+1144311	4868Y	0	131420036	70037149066199075	96404	79931
DL755	+375933+1144372	4815Y	0	131420681	69919149932199112	96131	79[illegible]
DL75[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DRY LAKE VALLEY GRAVITY STATIONS

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL757	+375891+1144493	4777S	0	109420598	69771149738199050	95644	79460
DL758	+375876+1144470	4772U	0	111420575	69065149674199031	95551	79366
DL759	+375853+1144481	4764S	0	109420529	69791149559198995	95396	79258
DL760	+375831+1144490	4756S	0	109420488	69776149595198963	95301	79166
DL761	+375859+1144360	4798 9T	0	127420544	69967149635199003	95794	79555
DL762	+375864+1144236	4961Y	0	142420558	70149149724199011	97397	80618
DL763	+375805+1144339	4803 1T	0	132420445	70601149654198924	96125	79675
DL764	+375787+1144422	4746S	0	119420409	69060149553198896	95319	79250
DL765	+375701+1144439	4720S	0	121420249	69659149457198773	951 4	79126
DL766	+375727+1144333	4794 0T	0	133420301	70013150060198610	96366	80156
DL767	+375789+1144224	4966S	0	150420419	70179149435198901	97557	81091
DL768	+375727+1144204	4963Y	0	170420306	70202150196198610	98261	81455
DL769	+375653+1144219	4909Y	0	166420168	70183150730198702	98226	81069
DL770	+375648+1144303	4764 1T	0	149420156	70060150769198695	96997	80067
DL771	+375636+1144392	4698Y	0	131420130	69931149717198677	95254	79502
DL772	+375625+1144481	4711Y	0	108420107	69631149329198661	95003	79083
DL773	+375542+1144420	4677S	0	124419956	69941149576198540	95053	79225
DL774	+375528+1144337	4670S	0	151419933	71010152689198520	95719	79941
DL775	+375579+1144276	4731 0T	0	177420029	70103151205198594	97133	81170
DL776	+375491+1144254	4754 9T	0	186419867	70139151022198466	97719	81676
DL777	+375472+1144481	4668S	0	113419024	69060149441198436	94696	79101
DL778	+375456+1144374	4667S	0	142419802	69965150256198417	95762	79956
DL779	+375420+1144303	4746 1T	0	136419734	70071151068198362	97396	81341
DL780	+38 762+1144385	5618Y	0	108422213	69690147006200324	99556	80502
DL781	+38 761+1144303	5775Y	0	126422214	70010145064200323	100693	81122
DL782	+38 771+1144225	5627Y	0	124422236	70125146358200338	96976	79911
DL783	+38 815+1144274	5687Y	0	126422315	70050146385200402	49566	80255
DL784	+38 807+1144421	5856Y	0	146422695	69635145479200396	100204	80375
DL785	+38 819+1144491	5702Y	0	122422315	69733146537200406	99794	80466
DL786	+38 873+1144352	5747Y	10	122422420	69933146349200487	99947	80477
DL787	+38 922+1144445	5665Y	0	136422507	69795146689200559	99635	80581
DL788	+38 755+1144039	5712U	0	128422213	70396145450200314	93694	79540
DL789	+38 790+1144118	5761U	0	130422282	70279145386200371	99233	7971-
DL790	+38 794+1143968	5702Y	0	146422286	70498145081200371	99738	80231
DL793	+38 834+1143876	5647Y	0	202422365	70627146112200430100712		80972
DL795	+38 930+1143983	6304Y	0	155422539	70470143360200570102142		80795
DL800	+38 892+1144276	6034Y	0	149422458	70045144713200515100960		80558
DL801	+381022+1144485	5749Y	0	117422691	69735146295200705	99697	80215
DL803	+38 997+1144400	6073Y	0	150422647	69657144792200660101204		80726
DL804	+38 963+1144323	6117Y	0	164422587	69711144796200619101001		80960
DL805	+381005+1144263	6658Y	0	356422657	70157141123200680103199		80787
DL811	+38 957+1143793	6153Y	0	124422596	70746144553200609101466		80672
DL819	+381060+1144425	5953Y	0	125422770	69616145734200772100989		80616
DL820	+381149+1144439	6165Y	76	161422927	69794143736200891102957		80161
DL826	+381213+1144420	5872Y	0	125423006	69010145330200984100184		80281
DL829	+375339+1147674	6509S	0	504419607	70996141428197684100446		82760
DL839	+374176+1145261	5031Y	0	121417400	68719158612196516	99283	82205
DL840	+374174+1145289	5073Y	0	127417396	68674160285196545	99465	82309
DL841	+374173+1145315	5111Y	0	133417393	68640160160196541	99727	82426
DL842	+374175+1145342	5157Y	0	139417396	68610147056196515	99945	825
DL843	+374177+1145365	5191Y	0	150417399	68566147860196540	100170	82626
DL844	+374180+1145395	5233Y	0	162417403	68522147780196556	100483	82997
DL845	+374179+1145423	5265Y	0	196417400	68481147730196551	100780	83026
DL846	+374181+1145454	5330Y	0	220417403	68435147316196553	101125	83150
DL847	+374180+1145482	5372Y	0	232417400	68394147332196552	101352	83267
DL848	+374186+1145509	5412Y	0	223417411	68356147123196561	101497	83267
DL849	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	F.A.	CBA +1000
DL850	+374090+1145431	5564S	0	167417236	68473146010196421101396		62784
DL851	+374093+1145303	5055Y	0	145417245	68661148457196425	99606	62509
DL855	+373952+1145313	5120Y	0	115416984	68652147895196220	99861	62513
DL856	+373971+1145418	5310S	0	143417016	68497146009196624710053 6		62506
DL857	+373960+1145542	5599S	0	196416992	68315145330196231101794		62693
DL858	+373872+1145328	5050Y	0	118416636	68633148205196103	99622	62516
DL859	+373891+1145439	5266S	0	121416667	68469147650196130101309		63462
DL860	+373936+1145665	5638S	45	280416943	68135146346196196101215		62510
DL861	+373820+1145273	4974S	0	101416742	68716148657196027	98581	61977
DL862	+373802+1145383	5059Y	0	105416705	68555147479196001	99189	61939
DL863	+373857+1145469	5211S	0	120416603	68397147608196081100769		63116
DL864	+373779+1145408	5113Y	0	110416658	68387147635195967	99187	61456
DL865	+373856+1145596	5208B	0	141416797	68240145610196080100299		62472
DL866	+373866+1145686	5247B	0	186416613	68104147055196095100363		62653
DL867	+373821+1145714	5155S	0	141416729	68060147627196029	99713	62272
DL868	+373880+1145791	5219B	0	199416636	67952147424196115100433		62631
DL869	+373820+1145624	5072S	0	138416724	67906147779196027	99466	62312
DL870	+373896+1145886	5162S	0	209416662	67612147574196136100626		62625
DL871	+373820+1145934	5058S	0	123416720	67744147787196027	99362	62233
DL874	+374043+1145577	6018S	0	332417144	68260142435196352102723		62530
DL878	+374221+1145343	5304S	0	147417461	68597147023196612100579		62586
DL881	+374310+1145278	5012S	0	150417648	68686149063196741	99476	62526
DL882	+374313+1145376	5308S	12	156417650	66544147624196746100433		62477
DL883	+374373+1145265	4980	0	145417764	68705149277196834	99311	62470
DL886	+374434+1145272	5034S	0	132417877	68692149080196925	99533	62495
DL887	+374430+1145330	5132S	0	152417868	68607148504196916	99926	62574
DL888	+374414+1145423	5294B	0	207417835	68471147729196893100056		62606
DL889	+374432+1145514	5614S	0	197417865	68337146130196920102047		63096
DL890	+374465+1145379	5202S	0	164417931	68534148175196966100165		62557
DL891	+374495+1145467	5399Y	0	228417983	68403147306197012101106		62920
DL892	+373819+1144835	48640	0	108416755	69364144472196026	97664	61387
DL893	+373937+1144634	47200	0	103416917	69358146742196154	97607	61012
DL894	+373996+1144635	46680	0	101417082	69353148677196284	96523	60703
DL895	+374083+1144634	46590	0	96417243	69351148975196410	96220	60494
DL896	+374170+1144835	46170	0	94417404	69305149154196536	96067	60415
DL897	+374193+1144834	4612S	0	95417446	69340149203196571	96035	60400
DL898	+374213+1144833	46090	0	93417485	69346149235196602	96006	60361
DL899	+374235+1144832	4602S	0	94417524	69347149258196632	95934	60352
DL900	+374259+1144831	45960	0	94417568	69347149284196667	95869	60255
DL901	+374289+1144828	45930	0	93417624	69351149269196711	95800	60225
DL902	+374315+1144829	4590S	0	94417672	69348149295196746	95742	60160
DL903	+374347+1144829	45870	0	92417731	69347149316196795	95688	60135
DL904	+374369+1144834	4586S	0	93417772	69338149320196827	95651	60112
DL905	+374391+1144839	4584S	0	93417812	69330149359196859	95659	60097
DL906	+374411+1144842	4564S	0	92417849	69325149381196889	95631	60069
DL907	+374432+1144846	4568S	0	92417886	69315149414196920	95634	60091
DL908	+374459+1144851	4581S	0	93417928	69310149117196952	95576	60045
DL909	+374476+1144856	4580S	0	93417969	69301149436196984	95548	60023
DL911	+374167+1144517	4735S	0	111417409	69913149035196533	97663	61424
DL912	+374169+1144548	4660S	0	109417412	69767149351196536	97454	61205
DL913	+374170+1144576	4646S	0	106417413	69726149620196536	97105	61305
DL914	+374170+1144602	4639S	0	104417412	69688149711196536	96746	61055
DL915	+374175+1144631	4615S	0	102417411	69645149492196535	96366	60747
DL916	+374170+1144665	4610S	0	99417410	69595149235196538	96081	60457
DL917	+374169+1144696	4667S	0	97417407	69550149133196536	95953	60536
DL919	+374171+1144725	46670	0	96417409	69510149091196539	95908	60490
[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FA	[illegible] +1[illegible]
DL920	+374171+1144780	46009S	0	94417407	69420149118196539	95953	60327
DL921	+374171+1144807	4612S	0	95417406	69386149134196539	95995	60562
DL922	+374172+1144876	4628S	0	95417406	69285149157196541	96171	60481
DL923	+374171+1144902	4644S	0	94417403	69247149154196539	96519	60574
DL924	+374173+1144926	4660S	0	96417406	69209149165196541	96478	60680
DL925	+374174+1144957	4662S	0	94417407	69160149221196543	96739	60665
DL926	+374172+1144983	4702S	0	95417402	69128149307196541	97017	61075
DL927	+374172+1145011	4729S	0	95417401	69080149349196541	97313	61260
DL928	+374172+1145037	4754U	0	98417400	69046149340196541	97540	61423
DL929	+374173+1145057	4778U	0	100417402	69019149265196541	97649	61493
DL930	+374174+1145083	4798S	0	101417403	68981149232196543	97642	61579
DL931	+374171+1145110	4830U	0	104417396	68941149125196539	98042	61672
DL932	+374176+1145134	4854S	0	105417405	68906149055196546	98190	61740
DL933	+374172+1145162	4890U	0	108417396	68665148682196541	98364	61797
DL934	+374177+1145204	4949U	0	112417404	68603148642196546	98670	61902
DL935	+374177+1145231	4964S	0	113417403	68763148567196546	98924	62043
DL936	+373819+1144556	5058U	0	147416764	69771148214196026	99602	62566
DL937	+373825+1144643	4927U	0	124416772	69643148259196034	98592	61911
DL938	+373819+1144722	4850U	0	117416758	69527148570196026	98188	61763
DL939	+373895+1144609	4863S	0	122416903	69690148730196137	98359	61695
DL940	+373907+1144502	4960U	0	162416929	69846149080196154	99793	62470
DL941	+373907+1144724	4754U	0	109416921	69520148691196154	97477	61371
DL942	+373939+1144588	4827U	0	120416985	69719149092196201	98518	61974
DL943	+373994+1144502	4892U	0	127417090	69843149349196280	99107	62549
DL944	+373994+1144614	4752U	0	112417086	69676149147196280	97587	61491
DL945	+373995+1144724	4671U	0	106417084	69516148989196282	96740	60607
DL946	+374081+1144516	4772S	0	114417250	69615149794196408	98295	62155
DL947	+374082+1144625	4668S	0	105417248	69656149302196409	96623	61007
DL948	+374083+1144723	4654U	0	100417247	69514149052196410	96251	60546
DL949	+374211+1144533	4675S	0	108417490	69787150232196597	97631	61793
DL950	+374232+1144637	4566U	0	100417525	69634149410196626	95971	60429
DL951	+374259+1144721	4584U	0	94417572	69509149179196667	95652	60111
DL952	+374278+1144561	4598S	0	104417613	69743150306196695	96682	61303
DL954	+374346+1144607	4580U	0	97417737	69673149475196794	95754	60260
DL955	+374346+1144717	4560U	0	92417733	69511149217196794	95525	79996
DL956	+374405+1144625	4579U	0	94417846	69644149423196880	95035	80111
DL957	+374430+1144521	4595S	0	102417895	69795150159196916	96485	60915
DL958	+374432+1144731	4580S	0	89417892	69487149245196920	95427	79495
DL959	+374495+1144785	4560S	0	89418006	69405149309197012	95399	79667
DL960	+374495+1144588	4557S	0	93418013	69694149621197012	95777	80225
DL961	+374499+1145212	4912S	0	124417999	68771149764197017	98974	62545
DL962	+374457+114500346699T		0	100417929	69086150176196956	97163	61555
DL963	+374432+1144918	4619S	0	96417885	69212149013196920	96077	60451
DL964	+374432+1145062	4731U	0	105417880	69001150284196920	97666	61357
DL965	+374432+1145142	4854S	0	113417877	68854149305196920	98426	61904
DL966	+374346+1144940	4638U	0	96417729	69185149547196797	95598	60675
DL967	+374363+114501546890T		0	101417754	69073149916196819	97226	61334
DL968	+374348+1145105	4776U	0	111417724	68941149667196797	98018	61359
DL969	+374340+1145161	4835U	0	118417722	68859149665196797	98574	62101
DL970	+374289+114502547119T		0	100417617	69051149784196711	97417	61445
DL971	+374262+1144926	4651S	0	95417571	69200149303196672	96592	60629
DL972	+374218+1145120	4813S	0	111417538	68923149515196651	98166	61655
DL973	+374218+1145227	4949U	0	124417479	68767148785196607	98751	61996
DL974	+374114+114504147720T		0	98417300	69045149126196462	97574	61395
DL975	+374087+1144930	4672S	0	100417247	69201149111196416	96563	60728
DL976	+374001+1144993	4660S	0	100417087	69194149284196291	96636	60974
[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL978	+374087+1145139 4868S	0	110417240 689021487411906416	98137	81644
DL979	+374105+1145222 4964S	0	122417270 687791485561906443	98830	82021
DL980	+374017+1145140 4921U	0	126417119 689041483391906314	98365	81097
DL982	+373912+1144949 4712S	0	102416923 691891492191906161	97402	81455
DL983	+373949+1145060 47539T	0	130416987 690241490991906215	97624	81539
DL984	+373907+1145162 4969U	0	115416906 686761480191906154	98544	81742
DL985	+373896+1145217 4990S	0	110416884 687961481541906138	98978	82060
DL986	+373862+1145073 46041T	0	102416826 690091465891906086	97711	81428
DL987	+373820+1144996 4755S	0	104416751 691241487251906027	97447	81335
DL988	+373820+1145158 4862U	0	101416745 686851488131906027	96130	81566
DL989	+373776+1145086 46100T	0	101416066 689931460301905963	97333	81029
DL990	+373674+1145225 46629T	0	100416473 687931474251905814	97366	80693
DL991	+373692+1145089 46090T	0	114416511 689921476491905841	97066	80776
DL992	+373699+1145019 46461T	0	105416526 690951475671905851	97322	80598
DL993	+373706+1144918 49671T	0	108416543 692431472761905861	97595	80955
DL994	+373722+1144814 49459T	0	117416576 693961474071905844	98070	81517
DL995	+373726+1144696 4995Y	0	139416587 695691480451905896	99166	82266
DL996	+373736+1144600 51191T	0	159416609 697101477871905905100659		82759
DL997	+373714+1145955 4971U	0	99416523 677171479501905873	98860	82005
DL998	+373732+1145822 5090U		109416561 679121471971905899	99201	81644
DL999	+373687+1145600 49961T		96416484 681821470271905834	98212	81172
DL1000	+373728+1145662 5052S		101416561 682361469621905893	98014	81363
DL1001	+373670+1145494 4992S		95416457 685971471001905809	98271	81245
DL1002	+373661+1145371 4942S	0	99416444 685791471271905795	97641	81066
DL1003	+373672+1145259 4881U	0	99416468 687431474151905812	97539	80990
DL1004	+373729+1145273 4920U	0	97416573 687201474141905895	97822	81139
DL1006	+38 776+1145748 5537Y	0	102422193 678961465462005345	98714	79931
DL1007	+38 864+1145749 5678Y	0	114422356 678931465682005473	99553	80301
DL1008	+38 952+1145749 5815Y	0	125422518 678891466002006602100325		80616
DL1009	+381023+1145715 6371Y	0	265422651 679361430972007006102354		80669
DL1010	+38 928+1145655 5891Y	0	139422477 680261456962005671100773		80619
DL1011	+38 853+1145693 5768Y	0	114422337 679751466542004457100270		80643
DL1013	+38 874+1145574 5903Y	0	138422380 681481458162004860100885		80869
DL1014	+38 803+1145520 5722Y	0	125422250 682301469742003841100442		81 51
DL1015	+381001+1145578 6144Y	0	173422615 681371446792006741101831		81049
DL1016	+38 942+1145520 6150Y	0	152422507 682201444122005881101707		80663
DL1020	+38 805+1145289 5467Y	0	132422262 685671480512005867	99306	80722
DL1021	+38 864+1145310 5560Y	0	163422379 685341476282004673	99482	80661
DL1022	+38 906+1145362 5852Y	0	136422446 684571460562005351100600		80776
DL1023	+38 951+1145308 5659Y	0	160422531 685331466792006001	99537	80196
DL1024	+38 998+1145408 6039Y	0	175422615 683851447352006701100992		80060
DL1027	+381048+1145307 5823Y	0	179422710 685311450572007431100717		81036
DL1029	+38 36+1145357 5616Y	0	136420937 684971469961992621100569		81564
DL1030	+38 87+1145266 5413Y	0	129421934 686261462921990337	99696	81557
DL1031	+38 128+1145400 5563Y	0	133421906 684341473091993971100456		81547
DL1033	+38 173+1145297 5354Y	0	137421092 685821467661994065	99693	81569
DL1034	+38 217+1145256 5299C	0	123421175 686401492991995277	99557	81658
DL1035	+38 224+1145283 5342E	0	124421187 686011489891995377	99727	81631
DL1036	+38 230+1145311 5395E	2	117421197 685591486391995406	99667	81595
DL1037	+38 234+1145336 5476E	0	129421204 685201481771995521100162		81614
DL1038	+38 244+1145364 5576E	0	140421221 684811475431995661100555		81663
DL1042	+38 492+1145291 5306Y	0	128421516 685611492421997901100077		81656
DL1043	+38 439+1145333 5446Y	2	99421583 685191487031996561100163		81624
DL1046	+38 563+1145335 53569T	1	111421512 685101491352000335	99335	81240
DL1047	+38 563+1145437 54659T	2	93421609 683611482642000335	99673	81125
DL1048	+38 614+1145309 5518Y	0	96421905 684151480252001066	99659	81125
DL1051	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	CBA +1000
DL1052	+38 743+1145457	5506C	0	130422141	6832514795620029610044	61190
DL1053	+38 715+1145540	5562C	0	101422087	68204147772200255 99862	60993
DL1054	+374509+1143837	5393Y	0	120418066	70796146766197032100492	62215
DL1055	+374504+1143989	5815Y	0	309418051	70573144606197024102312	62738
DL1056	+374540+1144286	4935Y	0	148418107	70136150419197077 99785	83101
DL1057	+374515+1144401	4676Y	0	112418057	69968151361197041 98546	62509
DL1058	+374527+1144491	4640C	0	97418076	69635150108197056 96716	60987
DL1059	+374586+1144489	4650C	0	94418185	69635149916197144 96533	80767
DL1060	+374590+1144414	4697Y	0	102418195	69945150762197150 97619	61991
DL1061	+374601+1144520	4761Y	0	116418219	70083151409197166 99048	62926
DL1062	+374563+1144159	5621Y	0	253418154	70321146090197111101882	62963
DL1063	+374576+1144077	5441Y	0	128418181	70441147012197130101090	62061
DL1064	+374592+1143963	5466Y	0	129418215	70607147055197153101345	62831
DL1065	+374568+1143698	5301Y	0	125418173	70719147447197116100218	62265
DL1066	+374576+1143792	5421Y	0	118418192	70559146593197130100462	62111
DL1067	+374619+1143853	5258Y	0	132418269	70766147716197192100006	62207
DL1068	+374696+1143763	5416Y	0	142418415	70696147649197305101316	62960
DL1069	+374713+1143680	5273Y	0	167418442	70724148141197330100437	62620
DL1070	+374694+1143980	5281Y	0	123418403	70576148120197302100520	62531
DL1071	+374665+1144075	5121Y	0	128418346	70440149455197259100596	63052
DL1072	+374625+1144139	5575Y	0	243418270	70347146479197201101767	62975
DL1073	+374620+1144236	4928Y	0	140418257	70205150541197194 99724	63055
DL1074	+374637+1144279	4837C	0	122418287	70141151196197219 99216	62943
DL1075	+374642+1144318	4795C	0	109418295	70084151086197226 98988	62743
DL1076	+374646+1144345	4773C	0	105418301	70044151058197232 98745	62571
DL1077	+374648+1144372	4744C	0	107418304	70004150926197234 98337	62205
DL1078	+374652+1144398	4723C	0	98418310	69960150766197241 97913	61902
DL1079	+374660+1144424	4694Y	0	98418324	69928150457197252 97360	61406
DL1080	+374660+1144458	4671C	0	93418323	69876150111197252 96817	80979
DL1081	+374661+1144485	4651C	0	92418324	69836149933197254 96449	80676
DL1082	+374699+1144171	4937Y	0	137418405	70297150442197309 99595	62894
DL1083	+374729+1144241	5424Y	0	513418458	70193146902197355100596	62609
DL1084	+374735+1144354	4744C	0	101418465	70027150954197362 98238	62156
DL1085	+374745+1144439	4673Y	0	93418481	69902150123197376 96696	60601
DL1086	+374749+1.,40079	5031Y	0	118418501	70430149686197382 99851	62810
DL1087	+374789+1144156	4964Y	0	107418572	70315150020197441 99296	82472
DL1088	+374782+1143764	5490Y	0	174418574	70691147392197430101632	63081
DL1089	+374798+1143828	6369Y	0	862418601	70796141098197453103590	62729
DL1090	+374861+1143753	5870Y	0	195418720	70903145106197545102601	62975
DL1091	+374871+1143845	5942Y	232	330418755	70706144069197560102435	62730
DL1092	+374789+1143957	5130Y	0	155418580	70607149275197441100114	62773
DL1093	+374859+1143945	5196Y	0	155418709	70616148973197542100536	62709
DL1094	+374810+1144076	4967Y	0	119418614	70431150622197471 99484	62594
DL1095	+374683+1144071	4967Y	0	122418749	70435149796197577 99151	62262
DL1096	+374931+1143751	5642Y	38	254418850	70903146005197646102657	63106
DL1097	+374956+1143852	5417Y	0	212418881	70754147687197675101190	62927
DL1100	+375126+1143760	5772Y	0	290419190	70881145909197923102510	62913
DL1101	+375126+1143785	5728Y	4	255419239	70844146125197932102104	62651
DL1102	+375152+1143824	5642S	0	255419256	70785146573197970101772	62716
DL1103	+375219+1144555	6015T	0	241419379	70737140774198060101555	62945
DL1104	+375165+1143850	5577Y	0	231419279	70741147021197989101518	62725
DL1105	+375191+1143892	5494Y	0	218419307	70684147436198013101131	62611
DL1106	+375195+1143921	5444Y	0	204419332	70641147042198035101044	62680
DL1107	+375208+1143944	5167Y	0	210419355	70607146678198052100913	62641
DL1108	+375224+1143965	5373Y	0	197419384	70575148379198076100871	62742
DL1109	+375234+1143992	5321Y	0	191419401	70535148665198090100655	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV	FAA	CBA +1000
DL1111	+375131+1143870	5527Y	0	222419215	70719147233197940101310		82681
DL1112	+375120+1143951	5343Y	0	185419192	70601148249197923100610		82571
DL1113	+375167+1143989	5280S	0	181419278	70543148795197992100490		82562
DL1114	+375195+1144088	5106Y	0	150419326	70396149253198033	99273	82906
DL1115	+375138+1144059	5136Y	0	147419221	70441149406197950	99794	82424
DL1116	+375083+1144054	5104Y	0	144419120	70451149233197870	99402	82136
DL1117	+375012+1144033	5072Y	0	140418989	70485149034197766	99008	81849
DL1118	+374910+1144002	5096Y	0	139418802	70535149033197617	99375	82133
DL1119	+374981+1143922	5257Y	0	183418936	70650148230197720	99976	82229
DL1120	+375052+1143951	5259Y	0	181419066	70604148281197824	99950	82194
DL1121	+375229+1144227	4919S	0	127419384	70191150510198083	98720	82070
DL1123	+375200+1144428	4638S	0	112419323	69897150904198041	96511	80804
DL1124	+375194+1144326	4752Y	0	112419315	70047150916198031	97605	81510
DL1125	+375143+1144215	4697S	0	122419225	70212150488197957	98617	82037
DL1126	+375068+1144177	4901Y	0	123419088	70271150316197848	98593	82006
DL1127	+374963+1144164	4829Y	0	123418894	70295150450197695	98201	81654
DL1128	+374874+1144170	4925Y	0	111418729	70291150267197564	99049	82363
DL1129	+374949+1144227	4849Y	0	109418666	70204150626197674	98586	82156
DL1130	+375026+1144235	4821Y	0	112419012	70188150789197789	98370	82039
DL1131	+375081+1144230	4945Y	0	124419110	70193150117197866	98788	82046
DL1132	+375108+11443164751OT		0	108419157	71066150565197906	97078	81582
DL1133	+375137+1144391	4666Y	0	108419208	69955151152197946	97115	81306
DL1134	+375147+1144494	4617S	0	105419222	69603150403197963	95690	80247
DL1135	+375050+1144392	4674Y	0	101419047	69957151024197821	97189	81346
DL1136	+375059+1144493	4625C	0	98419060	69608150427197634	96117	80441
DL1137	+374975+1144446	4652C	0	96418906	69881150626197712	96696	80926
DL1138	+374995+1144333	4727Y	0	101418947	70046150946197741	97690	81606
DL1139	+374952+1144335	4736Y	0	100418867	70345150876197678	97769	81716
DL1140	+374875+1144280	4806Y	21	104418727	70129150423197560	98640	82300
DL1141	+374875+1144391	4696Y	1	96418723	69966150576197560	97503	81553
DL1142	+374824+1144403	4696Y	0	95418628	69951150769197491	97471	81559
DL1143	+374917+1144447	4648C	0	95418799	69882150646197627	96769	81002
DL1144	+374805+1144291	4854Y	0	105418597	70116150950197464	98979	82597
DL1145	+374508+1145335	5111Y	0	167418012	68596146952197030100622		82757
DL1146	+374575+1145427	5305Y	0	218418133	68459147646197126100645		82769
DL1147	+374587+1145287	5071S	0	135418160	68664149240197145	99018	82656
DL1148	+374636+1145347	5158S	0	169418248	68574148923197217100249		82825
DL1149	+374662+1145403	5501S	0	184418294	68490146543197255101060		82461
DL1150	+374644+1145463	5810S	0	231418259	68403143913197229101366		81750
DL1151	+374691+1145277	5128S	0	136418352	68074148678197296	99861	82487
DL1152	+374741+1145368	5048S	0	207418444	68026149625197370	99762	82752
DL1153	+374745+1145427	5916S	0	330418447	68452144722197376103025		83170
DL1154	+374706+1145524	6286S	0	395418372	68311141055197321103496		82495
DL1155	+374771+1145539	6708S	0	444418092	[illegible]		[illegible]
DL1156	+374831+1145486	5735S	0	211418604	[illegible]		82518
DL1157	+374819+1145366	5345S	0	158418586	[illegible]		[illegible]
DL1158	+374871+1145317	5010S	0	145418684	[illegible]	[illegible]	[illegible]
DL1159	+374904+1145126	5214S	0	171418741	[illegible]		[illegible]
DL1160	+374936+1145521	5306S	0	160418797	[illegible]		82923
DL1161	+374675+1145601	5602S	2	202418082	[illegible]		[illegible]
DL1163	+375000+1145552	5561S	51	188418915	[illegible]		[illegible]
DL1164	+374971+1145425	5198S	0	154418765	[illegible]		[illegible]
DL1165	+375023+1145307	5171Y	0	133418962	[illegible]	[illegible]	82444
DL1166	+375038+1145328	5076Y	0	121418992	68585149482197604	[illegible]	82252
DL1167	+375055+1145259	4952S	0	115419026	69085150336197629	99387	82510
DL1168	+375053+1145283	[illegible]	0	187419015	[illegible]		82423
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM OBSV GRAV THEO GRAV FAA	BA +1000
DL1170	+375109+1145457	5478S	0	149419119	68592147464197908101112	82577
DL1171	+375104+1145322	5404S	0	201419115	68591147146197906100107	81676
DL1172	+375160+1145371	5422S	0	144419216	68516147446197982100495	82140
DL1173	+375169+1145262	5069S	0	117419237	68676150126197995 99636	82664
DL1174	+375220+1145342	5169S	0	153419328	68555146997198070 99767	82222
DL1175	+375199+1145444	5617S	0	162419286	68408146577198039101403	82407
DL1176	+375212+1145522	5822S	0	226419308	68293145542198058102278	82647
DL1177	+375147+1145521	5668S	0	200419187	68297145575197965100957	81625
DL1178	+375217+1145597	6917S	01207419314		68185138461198065103591	81116
DL1179	+375119+1145627	6502S	236	554419132	68143139624197922103099	81712
DL1180	+375033+1145642	6498S	0	691418973	68124139627197797103190	81718
DL1181	+374949+1145312	5029S	1	121418828	68612149787197674 99443	82413
DL1913	+38 505+1145090	51418	0	111421713	68671150949199946 99383	81959
DL1914	+38 640+114489250951T		0	92021970	69155149937200145 97741	80455
DL1918	+375417+1144743	4652S	0	90419713	69426150632198357 96054	80277
DL1919	+374203+114503747520T		0	96417458	69047149399196585 97535	81425
DL1961	+374525+1144684	45800	0	87418065	69552149522197055 95568	80634
DL2000	+374595+1144984	46400	0	94418185	69166150362197157 96909	81103
DL2001	+374598+1145011	4666Y	0	97418189	69066150496197162 97245	81426
DL2002	+374599+1145038	4654Y	0	101418190	69029150603197163 97521	81646
DL2003	+374601+1145064	4715Y	0	100418193	68990150621197160 97827	81646
DL2004	+374593+1145089	4774Y	0	100418177	68954150561197155 98374	82151
DL2005	+374592+1145115	4776Y	0	112418175	68916150389197153 98163	82005
DL2006	+374590+1145178	4873Y	0	121418169	66824149805197150 98515	82016
DL2007	+374590+1145204	4918Y	0	115418168	68785149626197150 98762	82103
DL2008	+374589+1145232	4962Y	0	126418165	68744149501197146 99050	82252
DL2009	+374588+1145260	5010Y	0	125418162	68703149432197147 99435	82472
DL2010	+374586+1145313	5118Y	0	137418157	68626149013197144100035	82716
DL2011	+374585+1145338	5163Y	0	149418154	68589146685197143100132	82672
DL2012	+374583+1145365	5211Y	0	179418150	68549148376197140100260	82686
DL2013	+374585+1145402	5266S	0	175418152	68495147959197143100594	82740
DL2060	+373975+1145699	5260Y	0	283417008	67789147053196253100503	82646
DL2061	+374060+1145930	5552B	0	347417164	67741145373196377101249	82659
DL2062	+374127+1145921	5683b	0	248417286	67751144702196475101713	82576
DL2063	+374190+1145916	5549b	0	240417405	67753145826196566101499	82313
DL2064	+374360+1145506	5545Y	0	230417732	68349146229196614101601	82916
DL2065	+374272+1145324	50870	0	158417576	68622146091196686 99676	82083
DL2066	+375864+1144150	4754S	0	115420550	69635149608199211 95476	79337
DL2067	+375852+1144427	4766S	0	117420529	69676149614198993 95473	79335
DL2068	+375839+1144402	4773S	0	121420506	69407149603198974 95547	79369
DL2069	+375827+1144381	4775S	0	126420484	69436149662198956 95643	79483
DL2070	+375813+1144357	4790C	0	127420459	69974149767198930 95910	79699
DL2071	+375790+1144316	4832C	0	136420418	70035149962198902 96533	80189
DL2072	+375779+1144294	4806C	0	136420398	70066149962198885 96675	80419
DL2073	+375766+1144272	4906C	0	141420375	70160149971198867 97217	80660
DL2074	+375754+1144250	4932C	1	146420354	70133150017198850 97577	80902
DL2075	+375742+1144229	4962C	0	154420332	70165150006198832 97911	81141
DL2076	+375716+1144182	5026C	0	184420285	70235150072198795 98721	81784
DL2077	+375704+1144160	5073C	0	201420265	70267150056198777 99048	81967
DL2078	+375691+1144137	5161C	1	227420241	70302149616198758 99458	82172
DL2222	+36 741+1113770	6368Y	0	228422197	70791146197200694102027	80467
DL3001	+373951+1143210	53013	1	153417058	71173146503196210 10759	80608
DL3002	+374312+1143457	6724S	161	471417716	71364138675196745105219	82920
DL3003	+374715+1143314	6037S	251	238418467	71356143527197332103136	83012
DL3004	+374990+1143344	6778S	7	581416974	71497139620197734105062	82553
DL3006	+375587+1143934	6464Y	5	544420056	70564141124198605103171	81362
DL3007	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STATION IDENT.	LAT. DEG MIN LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM–OBSV GRAV–THEO GRAV–FAA	BA +1000
DL3008	+38 277+1143657	7778S	2	971421343	70977153257199615106856	81301
DL3009	+38 691+1143650	6155S	1	201422109	70967143439200220101149	80354
DL3010	+38 741+1143706	6048S	0	154422199	70683144452200294101081	80607
DL3011	+381026+1144003	6872Y	8	446422715	70936139183200711103154	80169
DL3014	+38 704+1145796	5377Y	0	96422058	67631147777200239 98143	79899
DL3015	+38 409+1145464	5773Y	8	129421523	68326146289199606100815	81262
DL3016	+375996+1145497	6059S	115	318420758	68297144156199204101960	81747
DL3017	+375701+1145334	5702S	16	174420218	68546146371198773101263	82005
DL3018	+375612+1145657	5262S	1	128420043	68079146694198642 99574	81755
DL3019	+375350+1145561	6660S	313	709419562	58230138747198259103172	81479
DL3021	+374846+1145751	5808S	7	164418623	67972146615197523101755	82116
DL3022	+374434+1145661	6590S	413	579417864	68121138318196923103422	81937
DL3023	+374011+1145712	6955S	2821	130417080	68063135029196305104187	81877
DL3024	+374260+1145916	5533S	249	169417534	67753145620196069101272	82001
DL3025	+373833+115 25	4988Y	-0	122416741	67010146314196046 99207	82316
DL3500	+375522+1144277	4707B	0	178419924	70104151386198511 97166	81291
DL3501	+375522+1144277	4707B	0	178419924	70104151389198511 97178	81301
DL3502	+375522+1144277	4707B	0	178419924	70104151399198511 97189	81311
DL3503	+375522+1144276	4708B	0	178419924	70106151405198511 97201	81321
DL3504	+375522+1144276	4709B	0	178419924	70106151406198511 97209	81327
DL3505	+375522+1144275	4709B	0	179419924	70107151411198511 97220	8133
DL3506	+375522+1144275	4710B	0	179419924	70107151415198511 97232	81345
DL3507	+375521+1144275	4711B	0	179419922	70107151417198509 97242	81353
DL3508	+375521+1144274	4712B	0	180419922	70109151422198509 97255	81365
DL3509	+375521+1144274	4713B	0	180419922	70109151422198509 97264	81370
DL3510	+375521+1144273	4713B	0	180419922	70110151426198509 97274	81379
DL3511	+375521+1144273	4714B	0	179419922	70110151429198509 97283	81384
DL3512	+375521+1144273	4715B	0	179419922	70110151431198509 97293	81392
DL3513	+375521+1144272	4715B	0	181419922	70112151437198509 97302	81401
DL3514	+375521+1144272	4716B	0	181419922	70112151439198509 97310	81406
DL3515	+375521+1144271	4717B	0	180419922	70113151436198509 97320	81412
DL3516	+375521+1144271	4719B	0	180419922	70113151441198509 97332	81420
DL3517	+375520+1144271	4719B	0	179419920	70113151440198508 97343	81426
DL3518	+375517+1144257	4751B	0	189419915	70134151596198503 97603	81585
DL3519	+375514+1144244	4792B	0	182419910	70153151277198499 97879	81715
DL3520	+375511+1144231	4831B	0	188419905	70172151165198495 98135	81845
DL3521	+375508+1144218	4867B	0	199419900	70191151133198491 98343	81943
DL3522	+375505+1144205	4906B	0	215419895	70211150675198486 98556	82046
DL3523	+375502+1144192	4955-	0	234419890	70230150659198481 98810	82144
DL3524	+375522+1144278	4706B	0	177419924	70103151380198511 97161	81285
DL3525	+375522+1144278	4706B	0	177419924	70103151373198511 97149	81275
DL3526	+375522+1144279	4705B	0	177419924	70101151366198511 97136	81266
DL3527	+375522+1144279	4705B	0	177419924	70101151360198511 97126	81256
DL3528	+375523+1144279	4704B	0	178419925	70101151353198513 97115	81246
DL3529	+375523+1144280	4704B	0	176419925	70100151349198513 97105	81237
DL3530	+375523+1144280	4703B	0	176419925	70100151338198513 97089	81225
DL3531	+375523+1144281	4703B	0	175419925	70096151331198513 97079	81213
DL3532	+375523+1144281	4703B	0	175419925	70096151323198513 97066	81202
DL3533	+375523+1144281	4702B	0	175419925	70096151317198513 97056	81175
DL3534	+375523+1144282	4702B	0	175419925	70097151305198513 97040	81177
DL3535	+375523+1144282	4701B	0	175419925	70097151298198513 97029	81170
DL3536	+375523+1144283	4701B	0	174419925	70095151291198513 97019	81159
DL3537	+375523+1144283	4700B	0	174419925	70095151284198513 97008	81150
DL3538	+375524+1144283	4700B	0	174419927	70095151277198513 96995	81139
DL3539	+375524+1144284	4699B	0	174419927	70094151271198513 96984	81129
DL3540	+375524+1144284	4699B	0	174419927	70094151266198513 96975	81121

STATION IDENT.	LAT. DEG MIN / LONG. DEG MIN	ELEV. +CODE	TER-COR. IN/OUT	NORTH UTM	EAST UTM / OBSV GRAV / THEO GRAV	FAA	CBA +1000
DL3542	+375530+1144210	46768	0	346419941	70202150681198523	96363	80762
DL3543	+375533+1144324	46726	0	162419942	70[illegible]50644198527	96081	80316
DL3544	+375536+1144337	46716	0	152419947	70[illegible]50417198531	95642	80064
DL3545	+375539+1144350	46728	0	145419953	69997150220198536	95057	79866
DL3546	+375542+1144363	46738	0	142419958	69977150063198540	95502	79705
DL3547	+375530+1144276	47078	0	179419939	70105151377198523	97153	81277
DL3548	+375530+1144276	47088	0	179419939	70105151381198523	97167	81287
DL3549	+375529+1144275	47098	0	180419937	70107151334198521	97181	81299
DL3550	+375529+1144275	47108	0	180419937	70107151337198521	97191	81306
DL3551	+375529+1144275	47118	0	180419937	70107151391198521	97203	81316
DL3552	+375529+1144274	47118	0	182419937	70108151397198521	97214	81327
DL3553	+375529+1144274	47128	0	181419937	70108151400198521	97225	81334
DL3554	+375529+1144273	47128	0	181419937	70110151409198521	97232	81342
DL3555	+375529+1144273	47138	0	181419937	70110151409198521	97244	81349
DL3556	+375529+1144273	47148	0	181419937	70110151414198521	97256	81359
DL3557	+375529+1144272	47158	0	182419937	70111151416198521	97266	81367
DL3558	+375530+1144277	47078	0	179419939	70104151372198523	97142	81258
DL3559	+375530+1144277	47068	0	180419939	70104151369198523	97133	81262
DL3560	+375530+1144277	47058	0	180419939	70104151363198523	97121	81253
DL3561	+375530+1144278	47058	0	178419938	70102151356198523	97110	81241
DL3562	+375530+1144278	47048	0	178419938	70102151347198523	97098	81230
DL3563	+375530+1144279	47048	0	179419938	70101151341198523	97085	81221
DL3564	+375530+1144279	47038	0	179419938	70101151336198523	97073	81211
DL3565	+375530+1144279	47028	0	179419938	70101151329198523	97061	81202
DL3566	+375530+1144280	47028	0	177419938	70099151321198523	97051	81190
DL3567	+375531+1144280	47028	0	178419940	70097151314198524	97037	81179

G1.0

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, LINCOLN COUNTY, NEVADA

GROUND-WATER RESOURCES - RECONNAISSANCE SERIES

Report 16

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, Lincoln County, Nevada

by

Thomas E. Eakin

Prepared cooperatively by the

Geological Survey

U. S. Department of the Interior

May
1963

FOREWORD

This is the 16th report in the series of reconnaissance ground-water studies which were initiated by action of the Legislature in 1960. In these sixteen reports, the ground-water resources of some nineteen valleys have been appraised and described.

The present appraisal of the ground-water resources of Dry Lake and Delamar Valleys in Lincoln County, Nevada, was made by Thomas E. Eakin, geologist, U. S. Geological Survey.

These reconnaissance ground-water resources studies make available pertinent information of great value to many State and Federal agencies. As development takes place in any area, demands for more detailed information will arise and studies to supply such information will be undertaken. In the meantime these reconnaissance type studies are timely and adequately meet the immediate needs for information on the ground-water resources of the areas on which reports are prepared.

Hugh A. Shamberger
Director
Department of Conservation
and Natural Resources

May, 1963

CONTENTS

ILLUSTRATIONS

TABLES

GROUND-WATER APPRAISAL OF DRY LAKE AND DELAMAR VALLEYS, LINCOLN COUNTY, NEVADA

by
Thomas E. Eakin

****

SUMMARY

The results of this reconnaissance of Dry Lake and Delamar Valleys suggest that average annual ground-water recharge from precipitation may be on the order of 6,000 acre-feet. Ground water is discharged largely by underflow through bedrock from the valleys, most probably to the southwest or south toward Pahranagat Valley.

The substantial depth to water, in excess of 300 feet in the topographically lower parts of the valleys, precludes low-cost development of substantial supplies of ground water. However, this apparently adverse feature for usual water-supply purposes may be desirable from the standpoint of possible special testing purposes required in modern technology.

The area roughly including Tps. 1 S. to 2 N., R. 64 E. may be most favorable for eventual interception of most of the recharge which is principally supplied from the mountains to the east and north. Here, perennial yield might closely approach the average annual recharge. It should be pointed out, however, that the depth to water, ranging from about 400 feet to 700 feet or more, probably precludes development of substantial water supplies for most purposes because of the high cost of pumping.

INTRODUCTION

Ground-water development in Nevada has shown a substantial increase in recent years. Part of the increased development is due to the effort to bring new land into cultivation, part is due to the effort to supplement surface-water supplies, and part is due to the general increased demands for water. In any case, as efforts to develop ground water increase, there is a corresponding increase in demand for information on the ground-water resources throughout the State.

Recognizing this need, the State Legislature enacted special legislation (Chapt. 181, Stats. 1960) for beginning a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U. S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources.

Interest in ground-water resources currently includes many areas and is extending to additional areas almost continuously. Thus, the emphasis of the reconnaissance studies is to provide as quickly as possible a general appraisal of the ground-water resources in particular valleys or areas where information is urgently needed. Ultimately, ground-water information will be available for practically all valleys of the State, at least at a reconnaissance level. For this reason each study is limited severely in time, field work for each area generally averaging about two weeks.

The Department of Conservation and Natural Resources has established a special report series to expedite publication of the results of the reconnaissance studies. Figure 1 shows the areas for which reports have been published in this series. A list of the titles of previous reports published in the series is given at the end of this report. This report is the sixteenth in the Reconnaissance Series.

The purpose of the Reconnaissance Series is to provide a general appraisal of the ground-water resources of virtually all valleys of the State for public information, and to provide a preliminary estimate of the amount of ground-water development that the areas might sustain on a perennial basis as an initial guide to possible requirements for administration of the areas under the State ground-water law.

The scope of this report is limited to a general description of the physical conditions of Dry Lake and Delamar Valleys, including observations of the interrelation of climate, geology, and hydrology as they affect ground-water resources; and possible movement of ground water between valleys is discussed. The report also includes a preliminary estimate of the average annual recharge to and discharge from the ground-water reservoir.

Location and General Features:

Dry Lake and Delamar Valleys are in central Lincoln County and lie within an area bounded by lat 37° 15' and 38° 28' N., and long 114° 33' and 115° W. The two valleys occupy a north-trending trough which is about 82 miles long and a maximum of about 20 miles wide between drainage divides. The combined area of the two valleys is nearly 1,300 square miles.

U. S. Highway 93 crosses the area in an eastward alinement about at the divide between Dry Lake Valley on the north and Delamar Valley on the south (fig. 2). Caliente lies along the highway about 20 miles east of the area.

A gravel road extends southward from U.S. Highway 93 to the former mining town of Delamar. State Highway 83 and improved roads connect formerly active mines on the western side of the Bristol Range with U.S. Highway 93 to the east in the vicinity of Pioche. Trails provide limited access to the lower parts of the valleys during fair weather.

The valleys are used principally for livestock range, although full use of the area may be somewhat limited by inadequate distribution of permanent watering points.

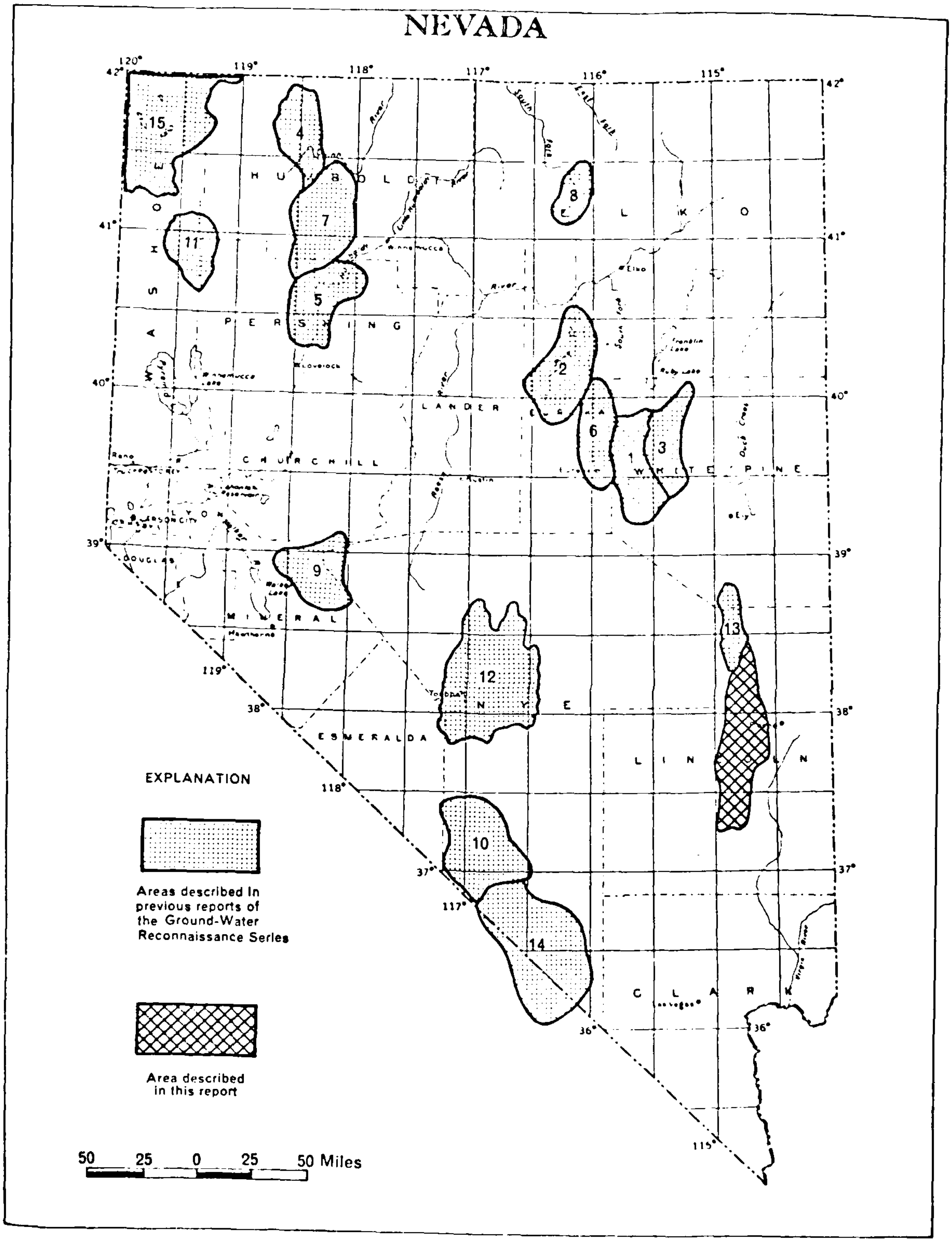


FIGURE 1. MAP OF NEVADA SHOWING AREAS DESCRIBED IN PREVIOUS REPORTS OF THE RECONNAISSANCE SERIES AND IN THIS REPORT.

Climate:

The climate of Dry Lake and Delamar Valleys is semi-arid. Precipitation and humidity generally are low, and summer temperatures and evaporation rates are high. Precipitation is irregularly distributed but generally is least on the valley floor and greatest in the mountains. Snow is common during the winter months and localized thundershowers provide much of the summer precipitation. The daily and seasonal temperature range is relatively large.

Records of precipitation are not available for Dry Lake and Delamar Valleys. However, the magnitude and distribution of precipitation in parts of the valleys probably are reasonably represented by the records for Alamo in Pahranagat Valley west of Delamar, and for Caliente and Pioche to the east (fig. 2). Table 1 lists the annual and the average monthly and average annual precipitation at Alamo, Caliente, and Pioche.

Maximum annual precipitation, in inches, during the period 1931-60 for Alamo, Caliente, and Pioche was 14.91 (1941), 18.73 (1941) and 22.38 (1941), respectively. Maximum monthly precipitation, in inches, for the same period was 6.15 (August 1945), 4.29 (October 1946), and 5.01 (August 1945), respectively. Minimum annual precipitation, in inches, for the respective stations was 1.23 (1956), 2.92 (1950), and 3.81 (1956). Minimum monthly precipitation has been zero a number of times at each of the stations.

Table 2 lists average monthly and annual temperature for the period 1931-60 at Alamo and Caliente and for the period 1939-60 at Pioche. Maximum and minimum temperatures recorded are: at Alamo, 115° F. on August 11, 1940, and -9°F. on January 21, 1937; at Caliente, 109°F. on June 22, 1948, and -31°F. on January 9, 1937; and at Pioche, 102°F. on June 22, 1954 and -5°F. on January 4, 1949.

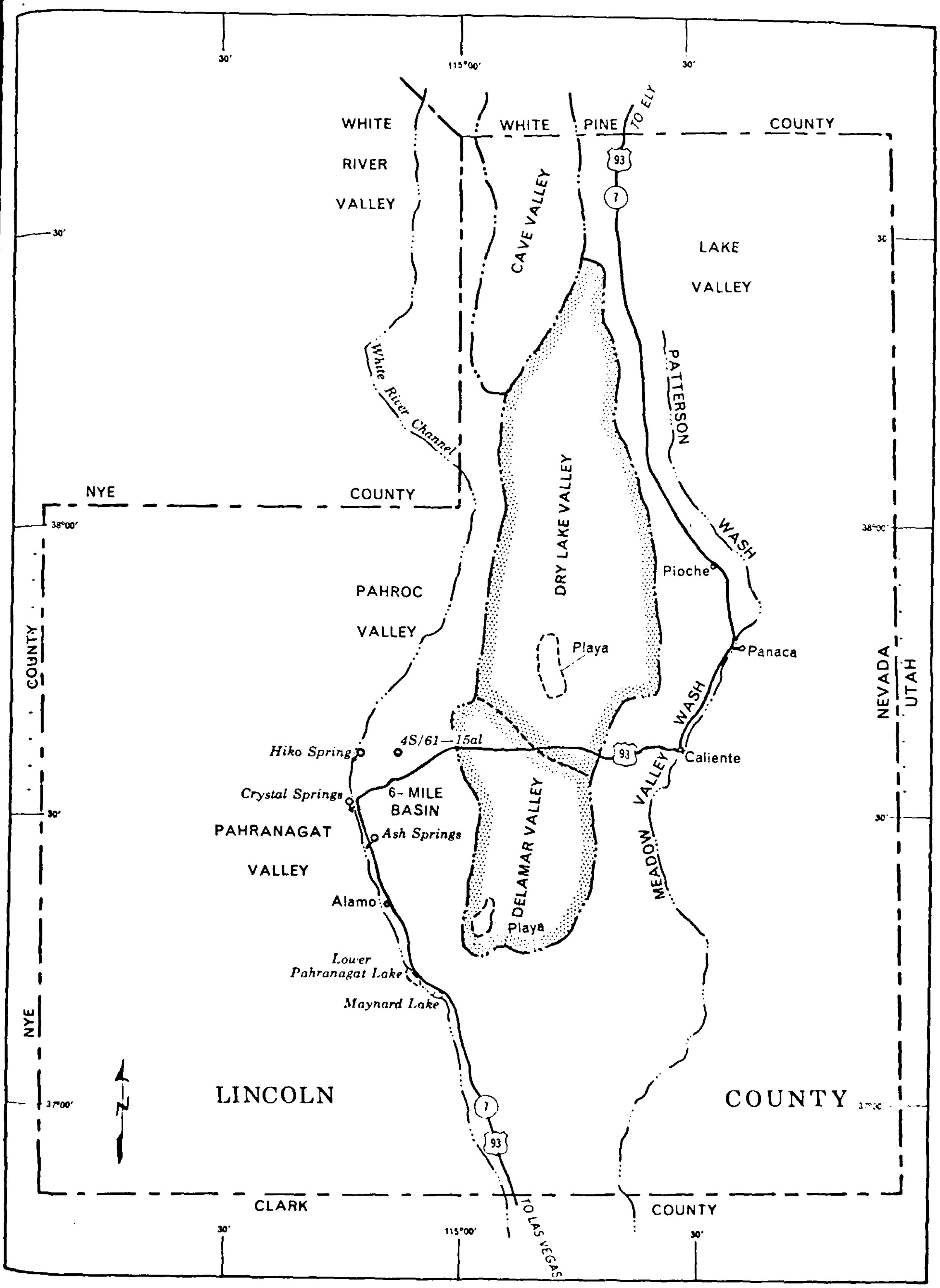


FIGURE 2. Sketch map showing relation of Dry Lake and Delamar Valleys to adjacent, areas

Table 1.--Summary of precipitation at Alamo, Caliente, and Pioche, Nev.
(from published records of the U.S. Weather Bureau)

Average monthly and annual precipitation, in inches, (1931-60)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	.70	.68	.68	.57	.45	.15	.73	.77	.32	.43	.43	.60	6.60
Caliente	.83	.79	.85	.70	.56	.39	.76	.92	.49	.89	.75	.86	8.79
Pioche[1/]	1.55	1.26	1.46	1.19	.83	.33	.87	1.12	.69	1.18	.96	1.36	12.80

1/ Average for 1939-60.

Annual precipitation, in inches, (1931-61)

Year	Alamo	Caliente	Pioche	Year	Alamo	Caliente	Pioche
1931	9.60	9.49	--	1947	--	7.47	10.70
1932	9.68	11.61	--	1948	2.75	5.23	8.39
1933	7.29	8.16	--	1949	6.09	10.03	15.36
1934	3.01	7.14	--	1950	5.32	2.92	7.14
1935	5.58	9.43	--	1951	4.89	10.15	13.98
1936	8.97	11.60	--	1952	6.88	11.52	16.32
1937	6.30	6.84	--	1953	1.98	4.66	7.26
1938	11.15	--	--	1954	5.96	9.31	13.28
1939	7.42	9.41	10.05	1955	5.65	7.13	14.09
1940	6.16	7.49	13.48	1956	1.23	4.78	3.81
1941	14.91	18.73	22.38	1957	7.43	10.88	17.14
1942	2.94	6.63	7.18	1958	6.47	8.13	15.51
1943	--	11.70	16.08	1959	4.42	4.83	10.41
1944	--	7.96	11.59	1960	6.02	9.77	12.85
1945	10.65	11.60	20.60	1961	3.63	8.80	9.62
1946	--	12.36	14.04				

Table 2.--Average monthly and annual temperature, in degrees Fahrenheit, at Alamo, Caliente, and Pioche, Nev. for the period 1931-60

(from published records of the U.S. Weather Bureau)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Alamo	36.6	41.1	47.2	56.1	62.9	71.9	79.2	76.9	69.7	58.6	46.8	39.3	57.1
Caliente	30.4	36.0	43.7	52.2	60.2	68.5	75.9	73.9	65.9	54.1	41.5	33.5	52.9
Pioche 1/	29.5	33.6	39.3	48.6	57.0	66.3	73.9	71.7	64.8	52.8	40.3	34.0	51.0

1/ Average for 1939-60.

Low humidity and high temperatures are favorable for high rates of vaporation. Pan evaporation recorded at Caliente since 1956 is listed in able 3. Evaporation from May through September accounts for most of the nual total and averages about 50 inches for the 6-year period of record.

The average growing season in Dry Lake and Delamar Valleys has not een determined. An approximation of the probable growing season may be btained by reference to the nearby Upper Meadow Valley Wash, which is 20 iles east of this area. Houston (1950, p. 19) lists an average growing season f 157 days (May 2 to October 6), based on records at Caliente. Killing temperatures vary according to type of crop. In recent years Weather Bureau records st freeze data rather than killing frosts; the dates are listed for the occurrence f the last spring minimum and the first fall minimum for temperatures of 32°F. r below, 28°F. or below, and 16°F. or below. From these data the number of ays between the last spring minimum and the first fall minimum occurrence for e respective temperature groups are given. The following tabulation lists the mber of days for the three temperature groups recorded for the period 1952-61 Alamo, Caliente, and Pioche.

Number of days between temperatures of:
(from published records of the U.S. Weather Bureau)

	32°F or below			28°F or below			24°F or below		
ear	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche	Alamo	Caliente	Pioche
52	177	183	173	212	208	210	227	227	232
53	117	122	143	150	144	161	208	191	166
54	219	151	136	230	206	176	257	210	177
55	141	137	143	178	178	170	208	186	197
56	134	151	152	183	--	163	202	204	204
57	163	138	134	169	162	190	238	227	227
58	173	134	178	176	152	179	222	191	224
59	151	135	131	184	150	178	228	200	209
60	144	141	144	164	189	164	198	205	204
61	129	136	148	156	179	165	188	183	188
Aver-	154	142	148	180	174	175	217	202	180

Table 3.--Total evaporation at Caliente, Nev. (1956-61)

(from published records of the U.S. Weather Bureau)

Year	March	April	May	June	July	August	September	October	November
1956			7.42	[b]12.55	11.10	10.86	8.07	[b]4.65	2.05
1957	3.97	6.76	6.33	10.66	11.45	[b]11.60	7.54		
1958		[b]6.39	9.35	11.99	12.39	11.73	7.56	5.00	
1959		7.56	9.59	11.89	11.71	10.10	7.18		
1960			9.78	10.94	11.16	10.87	7.34	4.06	
1961		7.19	9.40	12.07	11.06	7.90	6.68	[b]4.07	
Average			8.64	11.67	11.48	10.51	7.39		

b/ Adjusted to full month by Weather Bureau.

ıysiography and Drainage:

Dry Lake and Delamar Valleys occupy a surficially closed trough in the reat Basin section of the Basin and Range physiographic province of Fenneman 931, p. 328). The north-trending trough is bounded on the east successively om the north by the Ely, Bristol, Highland Peak, and Delamar Ranges. A uthwest-trending spur of the Ely Range forms the northwest boundary of Dry ake Valley. The Pahroc (also Pahrock) Range bounds the central part of the ough on the west. On the southwest unnamed ranges, commonly with poorly fined drainage divides, comprise the boundary. The south end of Delamar lley is separated from Pahranagat Valley by a low alluvial divide.

The highest point in the mountains enclosing Dry Lake and Delamar lleys is Highland Peak with an altitude of about 9,500 feet. The crest of the ristol and Highland Peak Ranges is more than 8,000 feet above sea level for a stance of about 12 miles. The crest of the mountains along the northwest and st sides has an altitude of more than 7,000 feet for a combined distance of out 42 miles. Elsewhere the crests are less than 6,000 feet above sea level, cept for short segments whose altitudes are somewhat above 7,000 feet.

The lowest part of the trough of Dry Lake and Delamar Valleys is the aya or dry lake, in the southern part of Delamar Valley (see inside cover otograph) which has an altitude of slightly less than 4,400 feet. The altitude the playa in Dry Lake Valley is somewhat less than 4,600 feet. Dry Lake and elamar Valleys are separated by an alluvial divide whose saddle altitude is about 875 feet.

The trough of Dry Lake and Delamar Valleys is higher than those of hite River and Pahranagat Valleys on the west and Meadow Valley Wash on e east, which are tributary to the Colorado River (fig. 2). In Dry Lake and elamar Valleys the altitude decreases irregularly from about 5,400 feet at the titude of Fairview Peak in the north to about 4,400 feet at the north end of the elamar playa in a distance of about 55 miles, or an average decrease of 18 feet r mile. In the White River and Pahranagat Valleys to the west the altitude of e floor of the channel decreases from about 5,100 feet to 3,600 feet in the same stance, giving an average gradient of about 27 feet per mile. Similarily, in eadow Valley Wash and in Lake Valley to the east, the altitude decreases from ,900 feet to 3,900 feet in the same distance, giving an average gradient of about 6 feet per mile. Thus, the steeper gradients in the adjacent valleys result in e land surface altitude of the channels being substantially lower than the land urface altitude in the southern part of the trough of Dry Lake and Delamar alleys. In fact, the playa in Delamar Valley is nearly 1,200 feet higher than e floor of Pahranagat Valley in the vicinity of Maynard Lake. The topographic ositions and geology of these valleys largely control the occurrence and move- ent of ground water in the region. There are no perennial streams in Dry Lake nd Delamar Valleys, and the gross physiographic features of most of the stream hannels and washes probably were formed during periods of greater precipita- on--probably in Pleistocene time. Present-day streamflow occurs for short eriods only after high-intensity rains and from snowmelt runoff. Only runoff

from high-intensity rains can provide large volumes of flow to cause local erosion and substantial transport of sediments in sufficient quantity to modify stream channels and washes.

The main channel along the axis of the northern part of Dry Lake Valley is contained between relatively steep banks about 25 feet below the general level of the valley. The floor of the channel is covered with white sage, and the soil is fine-grained as it is in adjacent parts of the valley floor. This feature suggests that flash-flood erosion in this channel is most uncommon. Farther south, channels draining the Highland Peak and Delamar ranges have somewhat steeper gradients. In this area flood flows occasionally transport relatively coarse gravel to the lower part of the alluvial apron. One example of this was noted along a wash crossing the trail about in sec. 22, T. 1 N., R. 65 E.

During Pleistocene time, lakes occupied the playa areas of Delamar and Dry Lake Valleys. Tschanz and Pampeyan (1961) mapped about 16 miles of beach or strand line along the west, south, and southeast sides of the Dry Lake playa, and about 14 miles along the equivalent segments of the Delamar playa. These represent the highest shore lines identified in these valleys.

Maximum depths of the Pleistocene lakes were on the order of 75 feet in Dry Lake Valley and perhaps 50 feet in Delamar Valley, according to Carpenter (1915, p. 65, 66). The surface areas of the lakes in Dry Lake and Delamar Valleys were about 30 and 16 square miles, respectively.

GENERAL GEOLOGY

The following discussion of geology is based largely on the reconnaissance geologic maps of Tschanz and Pampeyan (1961) and Tschanz (1960). Other reports that relate to the geology in and adjacent to Dry Lake and Delamar Valleys include those prepared by Westgate and Knopf (1932), Callaghan (1936, 1937), Reso and Croneis (1959), and Kellog (1960).

For the purposes of this report the rocks of Dry Lake and Delamar Valleys are divided into two general groups and further subdivided into four major units. The distribution of these four units is shown on plate 1. One group primarily represents bedrock in the mountains. It is divided into a Paleozoic carbonate unit and a Paleozoic clastic and Tertiary volcanic and clastic rock unit.

Tschanz (1960, p. 198) indicates that the total thickness of Paleozoic rocks exposed in northern Lincoln County is between 30,000 and 33,000 feet. As described, one may infer that carbonate rocks (limestone and dolomite) probably constitute about 60 percent of the total section. This is somewhat less than the 80 percent of carbonate rocks in a total section of about 30,000 feet noted by Kellog (1960, p. 189) in his study of the southern Egan Range, which is 10 to 15 miles northwest of the area. The second unit of the bedrock group includes Paleozoic shale, sandstone or quartzite, and conglomerate and Tertiary volcanic rocks, chiefly tuff and intravolcanic sedimentary rocks. Because of

their importance to the ground-water hydrology of the region, the Paleozoic carbonate rocks are distinguished from Paleozoic clastic and Tertiary volcanic rocks on plate 1 as discussed subsequently in this report.

The second group is designated the valley fill and is divided into older and younger valley fill. The older deposit consists of unconsolidated to partly consolidated silt, sand, and gravel derived from adjacent highland areas, but also includes some rocks of volcanic origin. This unit was deposited largely under subaerial and lacustrine environments. Although data are not available, the maximum thickness of this unit probably is at least several hundred feet.

The younger valley fill includes clay, silt, sand, and gravel of Quaternary age and is largely restricted to stream channels and playa areas. As defined, this unit is relatively thin and probably is no more than a few tens of feet thick. The valley fill is underlain by bedrock, presumably similar in character to that exposed in the mountains.

Water-Bearing Properties of the Rocks:

The rocks of Paleozoic age generally have had their primary permeability, that is, permeability at the time of deposition, considerably reduced by consolidation, cementation, or other alteration. However, because they subsequently have been fractured repeatedly by folding and faulting, secondary openings have developed through which some ground water is transmitted. Further, fractures or joints in Paleozoic carbonate rocks locally have been enlarged by solution as water moves through them. Solution openings develop near sources of recharge where carbon dioxide carried by rain water penetrates the ground, where organic acids derived from decaying vegetation, or where otherwise derived acids may be carried by the water into contact with the carbonate rocks. Solution openings need not be restricted to the vicinity of present day recharge areas and outcrops of these rocks. Rather, they may occur wherever the requisite conditions have occurred anytime since the deposition of the carbonate rocks. The principal significance of solution openings is that they further facilitate movement of ground water through carbonate rocks.

Whether existing fractures or solution openings have extensive hydraulic connection or not is related to the overall geologic history of the rocks. In the absence of detailed information, ground-water movement through carbonate rocks in this region is assumed to occur both through fractures and solution openings. Certainly, the large quantity of ground water issuing from fractures and solution openings, such as those at Crystal and Ash Springs in Pahranagat Valley, is a dramatic demonstration that ground-water movement through Paleozoic carbonate rocks occurs in this region of Nevada.

The Paleozoic clastic rocks and the Tertiary volcanic and clastic rocks exposed in the mountains generally have little primary permeability. Secondary fractures probably are the principal means by which limited amounts of ground water are transmitted through them. Favorably disposed fractures in these rocks probably provide the network of openings through which water

moves and is discharged at small springs in the mountains and which yield a few gallons per minute to wells penetrating these rocks. Under extremely favorable conditions the distribution of fracture openings in welded tuff, lava flows, or Paleozoic clastic rocks may permit the development of moderate yields of water from wells. However, these occurrences are likely to be so localized that the odds of a well encountering them are very small indeed.

The unconsolidated sand and gravel of the valley fill in Dry Lake and Delamar Valleys is capable of transmitting ground water freely. However, most of the valley fill probably is composed of deposits of fine sand and silt. Grains of this size generally have relatively low permeability and, where saturated, transmit water much more slowly than coarse sand and gravel. Deposits of silty clay and clay may transmit water so slowly to wells that they will not yield supplies adequate for stockwatering purposes. Various parts of the valley fill probably are moderately consolidated or cemented and this further reduces the capacity of these deposits to transmit useful supplies of water to wells.

GROUND-WATER APPRAISAL

Occurrence of Ground Water:

Ground-water recharge in ~~Dry Lake and~~ Delamar Valleys is derived principally from precipitation within the surficial drainage area of the valleys. In a general way, ground water moves from recharge areas in and bordering the mountains toward the central parts of the valleys, thence southward or southwestward to discharge through . drock formations. This is in contrast with hydrologically closed valleys commonly found in the Basin and Range province. Carpenter (1915, p. 67) indicated that ground water in Bristol (Dry Lake) and Delamar Valleys probably finds an outlet in Pahranagat Valley. Snyder (1963, p. 400) refers to Dry Lake Valley as being a drained valley; that is, ground water moves out of the valley to discharge elsewhere.

In typical hydrologically closed valleys in the Great Basin, ground water is recharged from precipitation largely in the mountains enclosing the valley. Ground water moves from areas of recharge toward the ground-water reservoir in the valley fill underlying the central part of the valley. In or adjacent to the topographically lowest part of the valley, the water table, or upper surface of the zone of saturation, is within a few feet of land surface. Where the water table is close to land surface, ground water is discharged naturally by evaporation from the soil or from free-water surfaces and is transpired by plants (phreatophytes) which obtain most of their water from the zone of saturation or overlying capillary fringe.

Under long-term conditions in a hydrologically closed ground-water system, average annual recharge to the ground-water reservoir equals the average annual natural discharge. However, if a ground-water system in a topographically closed valley is hydrologically open, recharge from precipitation in the valley may be greater or less than the discharge within the valley. Where recharge from precipitation within the valley is greater than discharge in the valley, ground water must be discharging by underflow from the valley to an area

to areas of lower hydraulic head. Where the recharge from precipitation within the valley is less than discharge in the valley, recharge in part must be entering the valley from an area or areas beyond the topographic divide having a higher hydraulic head.

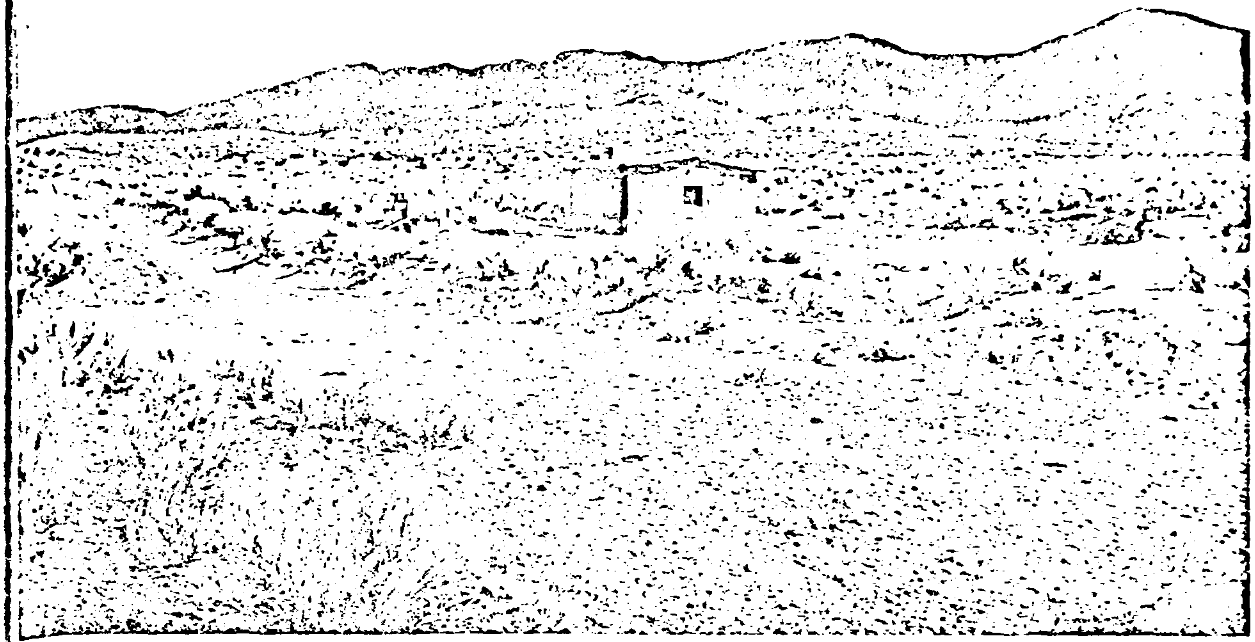
In addition to hydraulic controls, the water-bearing character of the rocks and their structure are important factors in the movement, or impedance to movement, of ground water. Where bedrock formations in the enclosing mountains are relatively impermeable, ground water normally is part of a closed hydrologic system in a topographically closed valley. Where the bedrock formations are at least locally permeable, the ground-water system may be hydrologically open. Winograd (1962, p. 110) has referred to this relationship in the vicinity of Yucca Flat in southern Nevada.

The chemical quality of the ground water is another factor that may be an aid in evaluating the nature of a ground-water system. Ordinarily, the concentration of chemical constituents shows considerable variation in different parts of a ground-water system. Generally, the concentration is least in areas of recharge and tends to be greatest in areas of natural discharge. Despite the normal variations that may be expected in the chemical constitutents in ground water in a given system, the character and concentration of one or more constituents may aid in identifying whether or not a given system is closed.

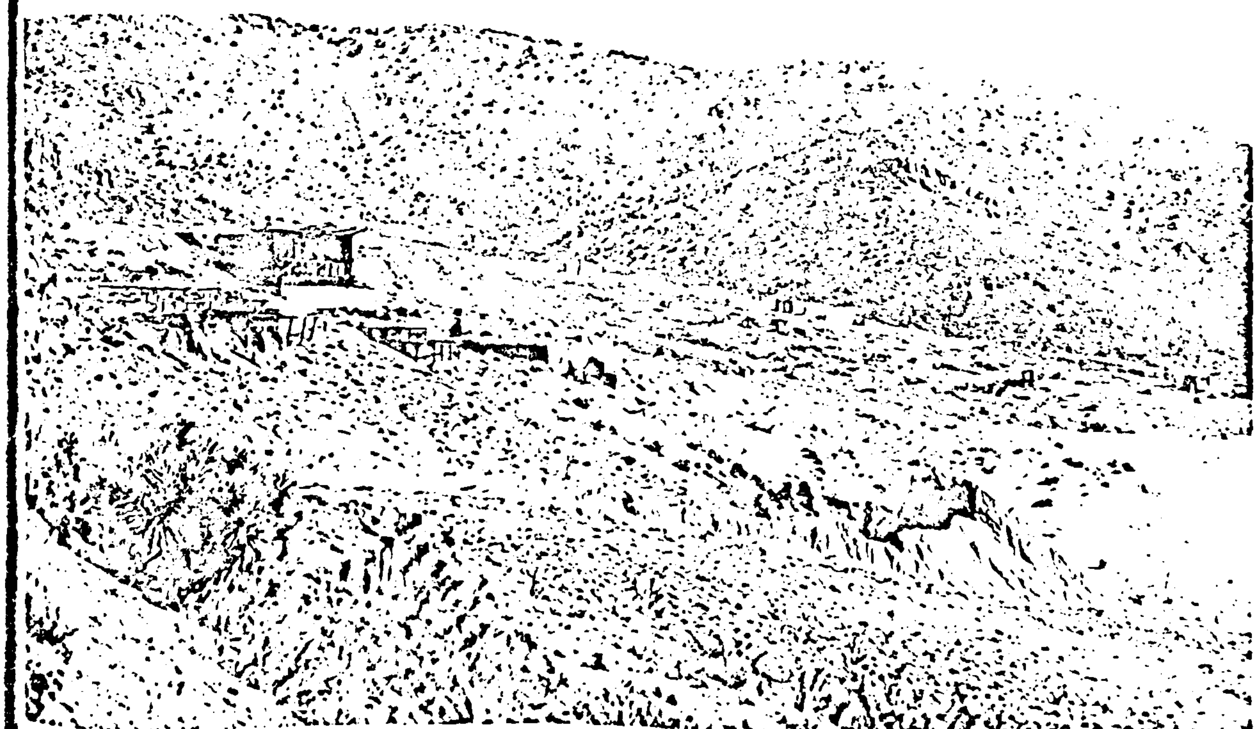
In summary, closed or open ground-water systems may be identified by the relationship of recharge to discharge within the valley, by potential hydraulic gradients between the reference valley and adjacent valleys, by the water-bearing character of geologic formations, including modifications by structural deformation, and by the chemical quality of the ground water with respect to that in adjacent areas.

In ~~Dry Lake and~~ Delamar Valleys, the principal areas of recharge are centered in the mountains along the northwest, northeast, and east sides of Dry Lake Valley. From the areas of recharge, ground water moves toward the central part of the valley. Along at least some of the stream canyons or washes ground water is not far below land surface, such as at Bristol wells (3N/65-21d3) (See cover photograph and photograph 3) and well 1N/65-2a1 where the depth to water is about 45 feet and 10 feet, respectively. Near the centers of the valleys the depths to water generally are substantial. For example, well 5N/64-14a1 is dry at a depth of about 240 feet, an altitude of roughly 5,385 feet: the depth to water in well 3N/64-20b1 is about 318 feet, altitude of about 4,820 feet; the depth to water in well 2N/64-3b1 is about 664 feet, altitude about 4,350 feet; and the depth to water in well 1N/64-24a1 is about 398 feet, altitude on the order of 4,300 feet.

In Delamar Valley, water for the mines and town of Delamar (photograph 4) was obtained from small springs and wells in the volcanic rocks in a nearby wash according to Callaghan (1937, p. 35). Callaghan further states that this supply was inadequate and that a well was drilled 900 feet deep in the alluvium of Delamar Valley which was dry throughout. The approximate well site is shown



Photograph 3. View east of stone cabin at Bristol Wells. Well 3N/65-21d2 is a short distance to the left of the cabin. The north end of the Bristol Range forms the skyline. Bristol Wells was an early water supply point for stock and travelers, it supported a small smelter operation and at least part of the water requirements of the Bristol Silver mine about 4 miles to the southeast, beyond the right side of the picture.



Photograph 4. View southeast of Delamar. Structure to left is remains of mill. Light colored band extending to right edge of picture is part of tailings. Wind action has heavily sculptured and removed a considerable volume of the tailings. In middle distance stone walls mark the principal area of Delamar townsite. Principal mining was in hill to left of left side of picture, although numerous prospect pits mark hill in background. Most of water supply for Delamar was brought in by pipeline from Meadow Valley Wash, 10 to 12 miles to the east.

AD-A112 959 ERTEC WESTERN INC LONG BEACH CA F/G 13/2
MX SITING INVESTIGATION. WATER RESOURCES PROGRAM. VOLUME II. RE--ETC(U)
SEP 81 F04704-80-C-0006
UNCLASSIFIED E-TR-53-2 NL

3 OF 3
AD A
112959

END
DATE
FILMED
05-82
DTIC

2959

1.0 2.8 2.5 2.2 2.0 1.1 1.8 1.25 1.4 1.6

as 6S/63-12a1 on plate 1. However, the details of drilling are not known. If the well literally did not encounter water throughout the full 900 feet, the water-level altitude in this area may be below about 3,700 feet, subject of course to the accuracy of land-surface altitude and the location of the well site.

The great depth to water below the playa areas of Dry Lake and Delamar Valleys precludes evapotranspiration losses from the ground-water reservoir in these valleys, except for extremely small amounts adjacent to scattered springs in the mountains. Inasmuch as the average annual ground-water recharge to Dry Lake and Delamar Valleys is estimated to be several thousand acre-feet per year (p. 34-37), and as no equivalent ground-water discharge by evapotranspiration occurs in the valleys, virtually all the ground water is discharged from the valleys by underflow through bedrock.

That ground water is discharged outside these valleys is further confirmed by the hydraulic gradients between Dry Lake and Delamar Valleys and adjacent valleys. As noted previously the altitude of the ground-water levels in Dry Lake and Delamar Valleys decreases southward along the axial part of the valleys. Available control points do not precisely define the altitude of the ground-water levels in the valleys. However, an apparent gradient is indicated by the water-level altitudes at the several drilling sites; that is, less than about 5,385 feet in sec. 14, T. 5 N., R. 64 E., about 4,820 feet at well 3N/64-20b1, about 4,350 feet at well 2N/64-3a1, and somewhat below about 3,700 feet at well 6S/63-12a1 in Delamar Valley. Thus, the hydraulic gradient is southward at more than 35 feet per mile in the northern part of Dry Lake Valley, and southward at somewhat more than 18 feet per mile from the north-central part of Dry Lake Valley to the central part of Delamar Valley.

Valleys to the east and west of Dry Lake and Delamar Valleys surficially drain to the Colorado River. Along the White River channel in Pahranagat Valley, Hiko Spring issues from about the alluvial-carbonate bedrock contact at an altitude of about 3,890 feet. About 5 miles south of Hiko Spring, Crystal Springs issue from limestone and alluvium at an altitude of about 3,815 feet. About 5 miles farther south in Pahranagat Valley, Ash Springs issue from limestone at the alluvial-bedrock contact at an altitude of about 3,610 feet. About 30 miles farther south in the vicinity of Lower Pahranagat and Maynard Lakes, at the south end of Pahranagat Valley, ground water in the alluvium is near land surface and is at an altitude of about 3,150 feet. Additionally, the depth to water in well 4S/61-15a1, about 6 miles east of Hiko Spring, is about 678 feet or an altitude of about 3,700 feet. Land surface along the White River channel and known water-level altitudes south of Maynard Lake along the White River channel are lower still. Maynard Lake is only about 10 miles southwest of the playa in Delamar Valley. Thus, ground water from Dry Lake and Delamar Valleys could discharge to Pahranagat Valley by underflow to the west, south, or southwest, based in terms of the potential hydraulic gradient.

Along Meadow Valley Wash to the east, land-surface altitude in the wash is above 4,000 feet northward from a point about 10 miles south of Caliente. The depth to water in the wash is generally within a few tens of feet below land surface;

therefore, the water-level altitude in Meadow Valley Wash probably is equal to or higher than that in Dry Lake and Delamar Valleys at equivalent latitudes throughout most of their lengths. For most of the same distance, the mountain area probably provides sufficient recharge to maintain a hydraulic divide between the two areas. Thus, a major transfer of ground water between the two areas does not seem likely.

In further considering ground-water discharge by underflow from Dry Lake and Delamar Valleys, the Paleozoic carbonate rocks appear to be the most favorable rocks to transmit ground water. The springs in Pahranagat Valley demonstrate that ground water moves through solution openings and fracture systems in some quantity, at least locally. Ground-water movement through similar Paleozoic rocks in Cave Valley, northwest of Dry Lake Valley, has been described in a previous report (Eakin, 1962). Drilling at the Nevada Test Site, about 75 miles southwest of this area, has shown that the Paleozoic carbonate rocks transmit ground water more readily than do the Paleozoic clastic rocks and Tertiary tuff (Winograd, 1962, p. 110). Thus, the Paleozoic carbonate rocks probably afford the best opportunity for ground-water movement between valleys in this area.

Plate 1 shows the surficial distribution of Paleozoic carbonate rocks in Dry Lake and Delamar Valleys. They are exposed most extensively along the east and northwest sides of Dry Lake Valley. Along the west and south sides of Delamar Valley, younger volcanic rocks crop out. However, Paleozoic carbonate rocks undoubtedly underlie the volcanic rocks in this area and, further, are exposed along White River channel in Pahranagat Valley and southward (Tschanz and Pampeyan 1961, and Bowyer, Pampeyan, and Longwell, 1958). Accordingly, the distribution of Paleozoic carbonate rocks in this area in favorable to the movement of ground water southward or southwestward from Dry Lake and Delamar Valleys to Pahranagat Valley.

If the Paleozoic carbonate rocks are capable of transmitting ground water by underflow from Dry Lake and Delamar, the converse may be true; that is, ground water may move into Dry Lake and Delamar Valleys from the north through carbonate rocks from valleys upgradient from Dry Lake and Delamar Valleys. This may be evaluated roughly as follows: In the northern part of Dry Lake Valley the lowest known water-level altitude is about 4,820 feet at well 3N/64-20b1. Higher water-level altitudes occur in White River Valley to the west and northwest; in Cave Valley to the northwest, and in Lake Valley to the north and east. However, the mountains enclosing the northern part of Dry Lake Valley are areas favorable to recharge from precipitation. Because they are areas of recharge, the water levels, in these mountain blocks also must be assumed to be areas of relatively high water levels. Thus, although actual water levels are not available in these areas, it is strongly inferred that ground-water divides occur beneath the mountains and thus provide hydraulic barriers to ground-water movement from adjacent valleys into the northern part of Dry Lake Valley. Similarly, it is inferred that a hydraulic divide exists in the Bristol and Highland Peak Ranges on the east side of Dry

Lake Valley and provides a hydraulic barrier to ground-water movement between Dry Lake Valley and Meadow Valley Wash. The same condition probably occurs in the Delamar Range on the east and southeast sides of Delamar Valley, although this range probably receives less recharge from precipitation than do the ranges to the north.

The mountains bordering the west side of Dry Lake and Delamar Valleys apparently provide only meager recharge from precipitation. The amount probably is not sufficient in magnitude or time to maintain a hydraulic barrier between Dry Lake and Delamar Valleys and White River and Pahranagat Valleys.

In summary, most, if not all, of the ground-water recharged to Dry Lake and Delamar Valleys is believed to be derived from precipitation within their surficial drainage areas. Ground water moves from the areas of recharge toward the central part of the valleys, thence generally southward or southwestward. Ground water is discharged from the trough of Dry Lake and Delamar Valleys by underflow through Paleozoic carbonate rocks to areas downgradient from the trough; that is, most probably into Pahranagat Valley, southwest of Delamar.

The depth to water in the central part of the trough of Dry Lake and Delamar Valleys is deep--probably too deep for economic recovery of ground water for the usual uses in this region, except possibly for stock purposes. Depths to water in the lower parts of the valleys decrease from somewhat more than 300 feet in T. 3 N., R. 64 E., to about 400 feet in the south part of T. 1 N., R. 64 E., to possibly more than 1,000 feet beneath the playa area of Delamar Valley. Perched or semiperched ground water in the mountains and upper parts of the alluvial apron locally supply water to small springs and locally is at a sufficiently shallow depth to permit the development of small water supplies by wells, such as at Bristol wells and well 1N/65-2a1.

Estimated Average Annual Recharge:

The average annual recharge to the ground-water reservoir may be estimated as a percentage of the average annual precipitation within the valley (Eakin and others, 1951, p. 79-81). A brief description of the method follows: Zones in which the average precipitation ranges between specified limits are delineated on a map, and a percentage of the precipitation is assigned to each zone which represents the probable average recharge from the average precipitation for that zone. The degree of reliability of the estimate so obtained, of course, depends on the degree to which the values approximate [illegible] actual precipitation in the several zones, and the degree to which the a[illegible]d percentages represent the actual proportion of recharge to ground water. Neither of these factors is know precisely enough to assume a high degree of reliability of the recharge estimate for any one valley. However, the method has proved useful for reconnaissance estimates and experience suggests that in many areas the estimates probably are relatively close to the actual long-term average annual recharge.

The precipitation map of Nevada (Hardman and Mason, 1949, p. 10) has been adjusted (Hardman, oral communication, 1962) to the improved topographic base maps (scale 1:250,000) now available for the whole State. The base map for plate 1 of this report was prepared from the same series of topographic maps. The several zones of precipitation applicable to Dry Lake and Delamar Valleys are as follows: the boundary between the zones of less than 8 inches and 8 to 12 inches of precipitation was delineated at the 6,000-foot contour; between 8 to 12 inches and 12 to 15 inches, at the 7,000-foot contour; between 12 to 15 inches and 15 to 20 inches, at the 8,000-foot contour; between 15 to 20 inches and more than 20 inches at the 9,000-foot contour.

The average precipitation used for the respective zones, beginning with the zone of 8 to 12 inches of precipitation, is 10 inches (0.83 foot), 13.5 inches (1.12 feet), 17.5 inches (1.46 feet), and 21 inches (1.75 feet).

The percentages of the average precipitation assumed to represent recharge for each zone are: less than 8 inches, 0; 8 to 12 inches, 3 percent; 12 to 15 inches, 7 percent; 15 to 20 inches, 15 percent; and more than 20 inches, 25 percent.

Table 4 summarizes the computation of recharge for Dry Lake and Delamar Valleys. The recharge (column 5) for each zone is obtained by multiplying the figures in columns 2, 3, and 4. Thus, for the zone of 12 to 15 inches of precipitation in Dry Lake Valley the computed recharge is 16,000 (acres) times 1.12 (feet) times .25 (25 percent) = about 1,300 acre-feet. The estimated total average annual recharge to ground water in Dry Lake and Delamar Valleys is about 6,000 acre-feet.

Table 4.--Estimated average annual ground-water recharge from precipitation in Dry Lake and Delamar Valleys, Nev.

(1) Precipitation zone (in inches)	Dry Lake Valley) (2) Approximate area of zone (acres)	(3) Average annual precipitation (feet)	(4) Percent recharged	(5) Estimated recharge (acre-feet) (2x3x4)	Delamar Valley (2) Approximate area of zone (feet)	(3) Average annual precipitaion (feet)	(4) Percent recharged	(5) Estimated recharge (ac.-ft) (2x3x4)
20+	200	1.75	25	100	0	- -	- -	- -
15-20	3,200	1.46	15	700	0	- -	- -	- -
12-15	16,000	1.12	7	1,300	4,000	1.12	7	300
8-12	114,000	.83	3	2,700	35,000	.83	3	900
8 -	442,000	- -	0	- -	208,000	- -	0	- -
	575,400 about 900 sq. mi.	Estimated average annual recharge (rounded)		5,000	247,000 about 385 sq. mi.	Estimated average annual recharge (rounded)		1,000

Estimated Average Annual Discharge:

Only a very small amount of ground water is discharged from Dry Lake and Delamar Valleys by evaporation and transpiration. Areas where ground water evaporates from soil or from free-water surfaces or is transpired by vegetation are restricted to isolated areas adjacent to the few small springs. The largest of these occurs near the spring at the Meloy Ranch in the southern part of T. 5 N., R. 65 E. Discharge was estimated to be about 20 gpm in March 1963. The few wells in the valley are used largely to provide water for stock, and the total withdrawals are very small. In the past, Bristol wells have been used in part to supply water requirements for mine camps and travelers. Similarly, wells and springs in Cedar Wash were used for water supply at Delamar. However, neither of these supplies were adequate.

Because of the great depth to water, no large areas of evapotranspiration from ground water occur in the lower parts of Dry Lake and Delamar Valley. Most of the ground water apparently is discharged by underflow through bedrock from Dry Lake and Delamar Valleys, but the amount cannot be directly determined. However, to the extent that the estimate of ground-water recharge is correct, and because over a long period of time recharge equals discharge, ground-water discharge by underflow is about 6,000 acre-feet per year minus the small amount, probably less than a few hundred acre-feet discharged by wells and by evapotranspiration adjacent to spring areas.

Perennial Yield:

The perennial yield of a ground-water system is the amount of natural discharge that can be salvaged for beneficial use from the ground-water system. It is the upper limit of the amount of water that can be withdrawn economically from the system for an indefinite period of time without causing a permanent and continuing depletion of ground water in storage and without causing a deterioration of the quality of water. The average recharge from precipitation and streams, discharge by evapotranspiration, discharge to streams, and underflow from a valley are measures of the natural inflow and outflow from the ground-water system.

In an estimate of perennial yield, consideration should be given to the effects that ground-water development of wells may have on the natural circulation in the ground-water system. Development by wells may or may not induce recharge in addition to that received under natural conditions. Part of the water discharged by wells may re-enter the ground-water reservoir by downward percolation, especially if the water is used for irrigation. Ground water discharged from wells theoretically is offset eventually by a reduction of the natural discharge. In practice, however, it is difficult to offset fully the discharge from wells by a decrease in the natural discharge, except when the water table has been lowered to a level that eliminates both underflow and evapotranspiration in the area of natural discharge. The numerous pertinent factors are so complex that, in effect, specific determination of perennial yield of a valley requires a very extensive investigation, based in part on data

that can be obtained economically only after there has been substantial development of ground water for several years.

The ground-water system in Dry Lake and Delamar Valleys, as presently understood, is such that economics probably is the controlling factor in the determination of perennial yield. The great depth to water in most of the valley more or less precludes large-scale withdrawals for most uses. Hydrologically, the saturated zone, or reservoir, underlying the floor of the valleys is the most likely area in which to develop substantial water supplies. At the depth of water indicated, the ground-water reservoir probably occurs largely in Tertiary rocks or in underlying Paleozoic carbonate rocks beneath the floor of the valleys.

Whether development occurs in the Tertiary or younger rocks of the valley fill or in the Paleozoic carbonate rocks, withdrawals for a long time would have to come largely from ground water in storage. The amount of stored ground water to be removed is many times the average annual recharge and undoubtedly would require many years of pumping. Pumping from storage would result in a lowering of water levels extending outward from the area of pumping farther and farther until the area of influence eventually would divert virtually all the water from areas of recharge to the area of pumping. After this was accomplished, pumping levels would tend to stabilize, providing that the average annual net withdrawals from pumping were equal to the recharge to the pumped area. The net withdrawals at that time would be equal to perennial yield. Thus, the perennial yield would be limited to the amount of inflow that could be diverted from the areas of recharge to the area of pumping influence.

Whether the magnitude of perennial yield ultimately equals total recharge to the valley depends upon the relative location of the area of pumping with respect to the several areas of recharge to the valley, the relation of the area of pumping with respect to the principal area of ground-water discharge or underflow from the valley, and the altitude of economic pumping levels with respect to altitude of natural discharge or underflow. In Dry Lake and Delamar Valleys, the costs of pumping relatively large quantities of ground water to modify appreciably the natural ground-water regimen to salvage all the natural discharge undoubtedly would be prohibitive for all but the most exceptional water requirements. However, to the extent that such development might occur, the area in and adjacent to Tps. 1 S. and 1 N., R. 64 E., is located favorably with respect to ground-water storage, and sufficient development might result ultimately in salvaging much of the discharge from Dry Lake Valley. However, it is conceivable that to salvage a large part of the estimated 6,000 acre-feet of average annual discharge from the valley, water levels might have to be drawn down as much as 1,500 feet below land surface.

Ground-Water in Storage:

The amount of ground water stored in the valley fill and underlying bedrock in Dry Lake and Delamar Valleys is substantial. It is many times the average annual recharge to and discharge from the ground-water reservoir in these valleys. To the extent that ground water may be developed, the volume of ground water in storage provides a reserve for maintaining an adequate supply for pumping during protracted periods of drought or for temporary periods of high demand under emergency conditions. This reserve, in effect, increases the reliability of ground water as a dependable source of supply and is an important asset in semiarid regions where surface-water supplies vary widely from year to year.

Chemical Quality:

The chemical quality of the water in most ground-water systems in Nevada varies considerably from place to place. In the areas of recharge the chemical concentration of the water normally is very low. However, as the ground water moves through the system to the areas of discharge, it is in contact with rock materials which have different solubilities. The extent to which the water dissolved chemical constituents from the rock materials is governed in large part by the solubility, volume, and distribution of the rock materials, by the time the water is in contact with the rocks, and by the temperature and pressure in the ground-water system.

The following analysis of water from Bristol well was reported by Carpenter (1915, p. 30). Constituents are listed in parts per million.

Silica	(SiO_2)	49	Carbonate	(CO_3)	0.0
Iron	(Fe)	.7	Bicarbonate	(HCO_3)	187
Calcium	(Ca)	76	Sulfate	(SO_4)	71
Magnesium	(Mg)	33	Nitrate	(NO_3)	32
Sodium plus Potassium	(Na + K)	37	Chloride	(Cl)	110
Total hardness as $CaCO_3$		325			
Total solids		509			

The analysis probably does not represent the typical chemical quality of ground water in Dry Lake Valley. However, it is somewhat suggestive of a mixed-water type found in the region. In some areas, ground water in Paleozoic carbonate rocks will contain a relatively high proportion of calcium magnesium, and bicarbonate due to solution of the carbonate rocks. As that water moves into Tertiary volcanic rocks or deposits derived from such rocks the proportion of sodium will increase partly by base exchange and partly by addition to the dissolved solids in the water until the water becomes a sodium-bicarbonate type. The relatively high chloride and nitrate in the analysis suggests local contamination, a condition that might well be expected from the local concentration of people and stock of the watering point when Bristol wells supplied water to the nearby mines and was the site of a small settlement and a smelter.

If it can be assumed that the analysis may be more or less representative of ground water in the lower part of Dry Lake Valley, with the exception of the high concentration of chloride and nitrate, the water would be suitable for domestic and stock purposes.

Development:

Small amounts of ground water from springs and wells are used to water livestock feeding on the range in Dry Lake Valley. Carpenter (1915, p. 66) reported that Bristol well (3N/65-21d1) formerly furnished the water supply for a smelter. He reported too, that several wells were dug in the vicinity and a small town sprung up around them. However, when Carpenter visited the area in 1912, only one well remained. This well had been in use to supply water to the traveling public and for miners at the Bristol mine a few miles east. The well could be pumped dry at that time during the filling of water tanks used to supply water at the mine. In October 1912 the well was 51 feet deep and water level was 43 feet below land surface. Seemingly the well has since been destroyed. There are three drilled wells in that area that are used to water stock. Reportedly, however, all three do not provide a sufficient supply to meet the needs.

Near Delamar, Carpenter (1915, p. 67) noted that water was piped from several springs, reported to be small seepages in the limestone and granite. Callaghan (1937, p. 35) also refers to the water supply of Delamar but refers to the earlier used springs and wells in a nearby wash as being developed in volcanic rocks. Carpenter also reported that well 6S/63-12a1, drilled 900 feet deep at the foot of the alluvial slope below Delamar, was dry. He further states that when the mine at Delamar was active, water supply was obtained from Meadow Valley Wash, which was pumped over the Meadow Valley Range (Delamar Range) through two 3 1/2-inch pipe lines.

Presently, ground water from wells and springs probably supplies less than 100 acre-feet per year and is used principally for watering stock in Dry Lake and Delamar Valleys. Development of ground water for irrigation probably would be prohibitive because of high pumping costs. Limited amounts of

ground water could be developed, if the need were great enough.

The very substantial depths to water in the central parts of Dry Lake and Delamar Valleys, which makes the cost of development of ground water too high for usual purposes, may make the area attractive for some types of special testing or operation required in modern day technology. In turn, ground water probably could be developed to meet limited water requirements of such activities.

DESIGNATION OF WELLS

In this report the number assigned to a well is both an identification number and a location number. It is referenced to the Mount Diablo base line and meridian established by the General Land Office.

A typical number consists of three units. The first unit designates the township; "N" after the number identifies the township as north of the Mount Diablo base line; "S" after the number identifies the township as south of the Mount Diablo base line. The second unit, a number separated by a slant line from the first, is the range east of the Mount Diablo meridian. The third unit, separated from the second by a dash, is the number of the section in the township. The section number is followed by a lower case letter, which designates the quarter section, and finally, a number designating the order in which the well was recorded in the quarter section. The letters a, b, c, and d, designate, respectively, the northeast, northwest, southwest, and southeast quarters of the section.

Thus, well number 3N/64-20b1 indicates that this well was the first well recorded in the northwest quarter of sec. 20, T. 3 N., R. 64 E.

Wells on plate 1 are identified only by the section number, quarter section letter, and serial number. The township in which the well is located can be ascertained by the township and range numbers shown on the margin of plate 1. For example, well 3N/64-20b1 is shown on plate 1 as 20b1 and is within the rectangle designated as T. 3 N., R. 64 E.

Table 5.--Records of selected wells in Dry Lake and Delamar Valleys, Lincoln County, Nev.

1N/64-24a1. Owners R. Lytle, S. A. Hollinger, and A. Delmue. Drilled stock well; depth 515 feet, casing diameter 5 inches. Reported depth to water below land surface 398 feet, January 17, 1959. This well caved between 428 feet and 515 feet. Driller's log:

Material	Thickness (feet)	Depth (feet)
Clay	3	3
Gravel, sandy	12	15
Clay	45	60
Sand and gravel, stratified	29-	350
Sand, fine	70	420
Lime, cemented	8	428
Clay	87	515
Total depth		515

1N/65-2a1. Owner not determined. Dug well; depth 12 feet, diameter 48 inches. Reported depth to water 10 feet.

2N/64-3b1. Coyote well. Owner, Bureau of Land Management. Drilled stock well; depth 742 feet; diameter, 6 inches; casing perforated 702 to 742 feet with torch-cut 1/4- x 8-inch slots, 6 to the round. Equipped with pump jack and gasoline pump. Reported depth to water, 664 feet, March, 1963.

2N/65-6b1. Owner not determined. Abandoned drilled well; depth 376 feet. Dry.

3N/64-20b1. Owner Bureau of Land Management. Unused, drilled stock well; depth 380 feet, casing diameter 6 inches. Depth to water below land surf--e 304 feet, when drilled; measured depth to water 316.54 feet, Mar. 11, 196

3N/65-21d1. Bristol well. Destroyed dug stock and domestic well. Reported depth, 51 feet. Reported depth to water 43 feet.

3N/65-21d2. Bristol well. Drilled stock well; casing diameter, 8 inches. Equipped with pump jack. Reported depth to water about 45 feet.

3N/65-21d3. Bristol well. Drilled stock well; casing diameter, 6 inches. Equipped with windmill and cylinder pump. . Reported depth to water, 45 feet.

3N/65-21d4. Bristol well. Drilled stock well; casing diameter, 5 inches. Equipped with pump jack and engine. Reported depth to water, 45 feet.

5N/64-14a1. Owner not determined. Drilled well; depth 239.5 feet. Dry.

REFERENCES CITED

Bowyer, Ben, Pampeyan, E. H., and Longwell, C. R., 1958, Geologic map of Clark County, Nevada: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-138.

Callaghan, Eugene, 1936, Geology of the Chief District, Lincoln County, Nevada: Univ. Nevada Bull., Geol. Mining Ser. 26, 32 p.

Callaghan, Eugene, 1937, Geology of the Delamar District, Lincoln County, Nevada: Univ. Nevada Bull., Geol. Mining Ser. 30A, 72 p.

Carpenter, Everett, 1915, Ground water in southeastern Nevada: U.S. Geol. Survey Water-Supply Paper 365, 86 p.

Eakin, Thomas E. and others, 1951, Contributions to the hydrology of eastern Nevada: Nevada State Engineer, Water Resources Bull. 12, 171 p.

Eakin, Thomas E., 1962, Ground-water appraisal of Cave Valley, Nevada: Nevada Dept. Conserv. Nat. Resources, Ground-Water Resources - Reconnaissance Ser. Rept. 13, 18 p.

Fenneman, N. M., 1931, Physiography of western United States: New York, McGraw - Hill, 534 p.

Hardman, George, and Mason, Howard G., 1949, Irrigated lands in Nevada: Univ. Nevada Agr. Expt. Sta. Bull. 183, 57 p.

Houston, Clyde E., 1950, Consumptive use of irrigation water by crops in Nevada: Nevada Univ. Agr. Expt. Sta. and Div. Irrigation and Water Conserv., Soil Conserv. Service, U.S.Dept. Agriculture Bull. 185, 27 p.

Kellog, Harold E., 1960, Geology of the southern Egan Range, Nevada: Intermountain Assoc. of Petroleum Geologists, Guidebook to the geology of east central Nevada, p. 189-97.

Reso, Anthony, and Croneis, Carey, 1959, Devonian system in the Pahranagat Range, southeastern Nevada: Geol. Soc. America Bull., v. 70, no. 9, p. 1249-1252.

Snyder, C. T., 1963, Hydrology of stock-water development in the Ely Grazing District, Nevada: U.S. Geol. Survey Water-Supply Paper 1475-L.

Tschanz, Charles M., 1960, Geology of northern Lincoln County, Nevada: Intermountain Assoc. of Petroleum Geologists, Guidebook to the geology of east central Nevada, p. 198-208.

Tschanz, C. M., and Pampeyan, E. H., 1961, Preliminary geologic map of Lincoln County, Nevada: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-206.

Westgate, Lewis G., and Knopf, Adolph, 1932, Geology and ore deposits of the Pioche District, Nevada: U.S. Geol. Survey Prof. Paper 171, 79 p., 8 pls., 13 figs.

Winograd, Isaac J., 1962, Interbasin movement of ground water at the Nevada Test Site, Nevada: U.S. Geol. Survey Prof. Paper 450-C, p. 108-111.

PREVIOUSLY PUBLISHED REPORTS OF THE GROUND-WATER RESOURCES RECONNAISSANCE SERIES

Rep. No.	
1	Ground-Water Appraisal of Newark Valley, White Pine County, Nevada. Dec. 1960, by Thomas E. Eakin.
2	Ground-Water Appraisal of Pine Valley, Eureka and Elko Counties, Nevada, Jan. 1961, by Thomas E. Eakin.
3	Ground-Water Appraisal of Long Valley, White Pine and Elko Counties, Nevada, June 1961, by Thomas E. Eakin.
4	Ground-Water Resources of Pine Forest Valley, Humboldt County, Nevada, Jan. 1962, by William C. Sinclair.
5	Ground-Water Appraisal of the Imlay Area, Humboldt River Basin, Pershing County, Nevada, Feb. 1962, by Thomas E. Eakin
6.	Ground-Water Appraisal of Diamond Valley, Eureka and Elko Counties, Nevada, Feb. 1962, by Thomas E. Eakin.
7	Ground-Water Resources of Desert Valley, Humboldt County, Nevada, April 1962, by William C. Sinclair,
8	Ground-Water Appraisal of Independence Valley, Western Elko County, Nevada, May 1962, by Thomas E. Eakin.
9	Ground-Water Appraisal of Gabbs Valley, Mineral and Nye Counties, Nevada, June 1962, by Thomas E. Eakin.
10	Ground-Water Appraisal of Sarcobatus Flat and Oasis Valley, Nye County, Nevada, Oct. 1962, by Glenn T. Malmberg and Thomas E. Eakin.
11	Ground-Water Resources of Hualapai Flat, Washoe, Pershing, and Humboldt Counties, Nevada, Oct. 1962, by William C. Sinclair.
12	Ground-Water Appraisal of Ralston and Stonecabin Valleys, Nye County, Nevada, Oct. 1962, by Thomas E. Eakin.
13	Ground-Water Appraisal of Cave Valley in Lincoln and White Pine Counties, Nevada, Dec. 1962, by Thomas E. Eakin.
14	Ground-Water Resources of Amargosa Desert, Nevada - California, March 1963, by George E. Walker and Thomas E. Eakin.
15	Ground-Water Appraisal of the Long Valley-Massacre Lake Region, Washoe County, Nevada, by William C. Sinclair; also including a section on The Soils of Long Valley by Richard L. Malchow.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

EXPLANATION

Valley Fill

Unconsolidated clay, silt, sand, and gravel of Quaternary age

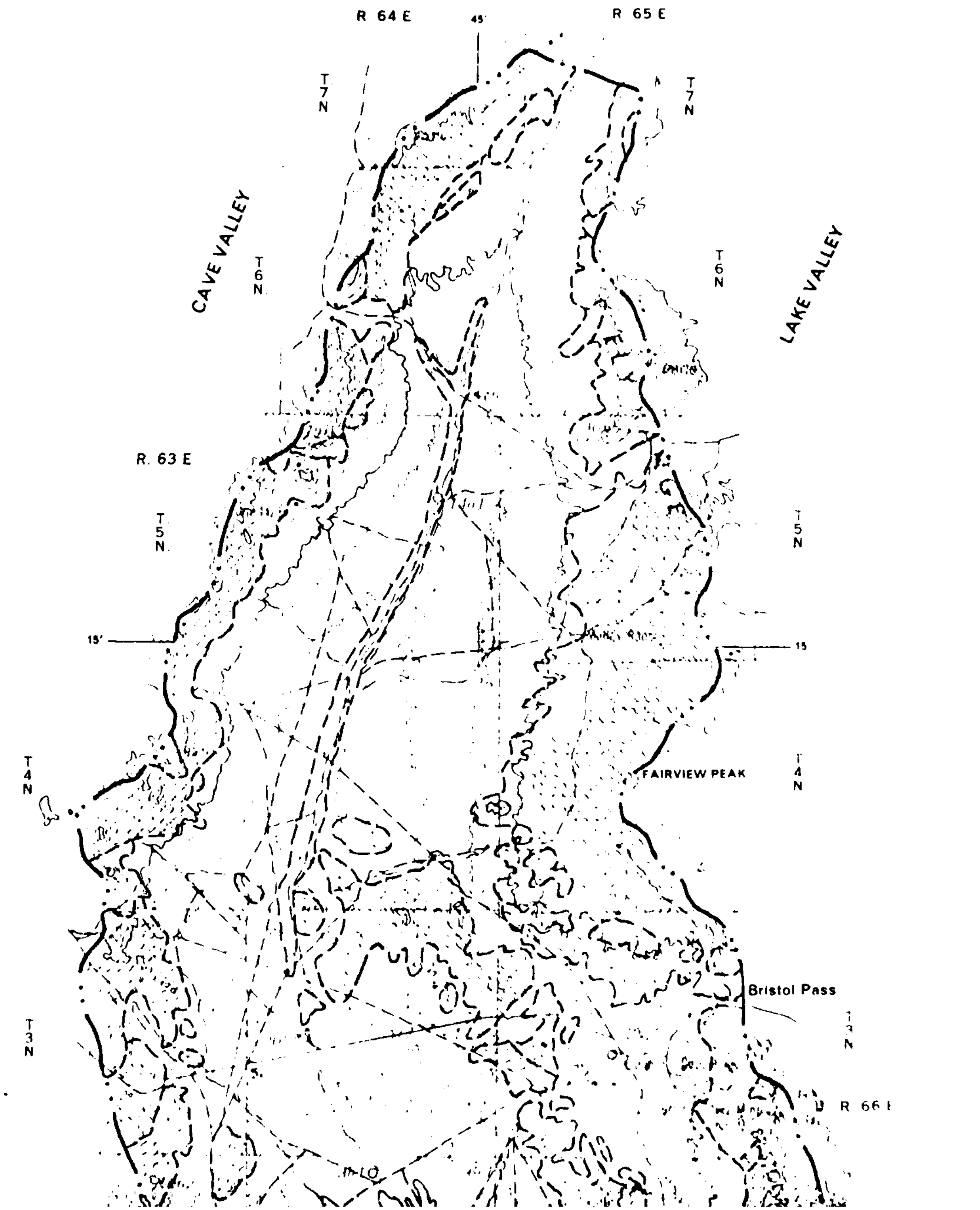
Unconsolidated and partly consolidated clastic rocks of Tertiary and Quaternary age

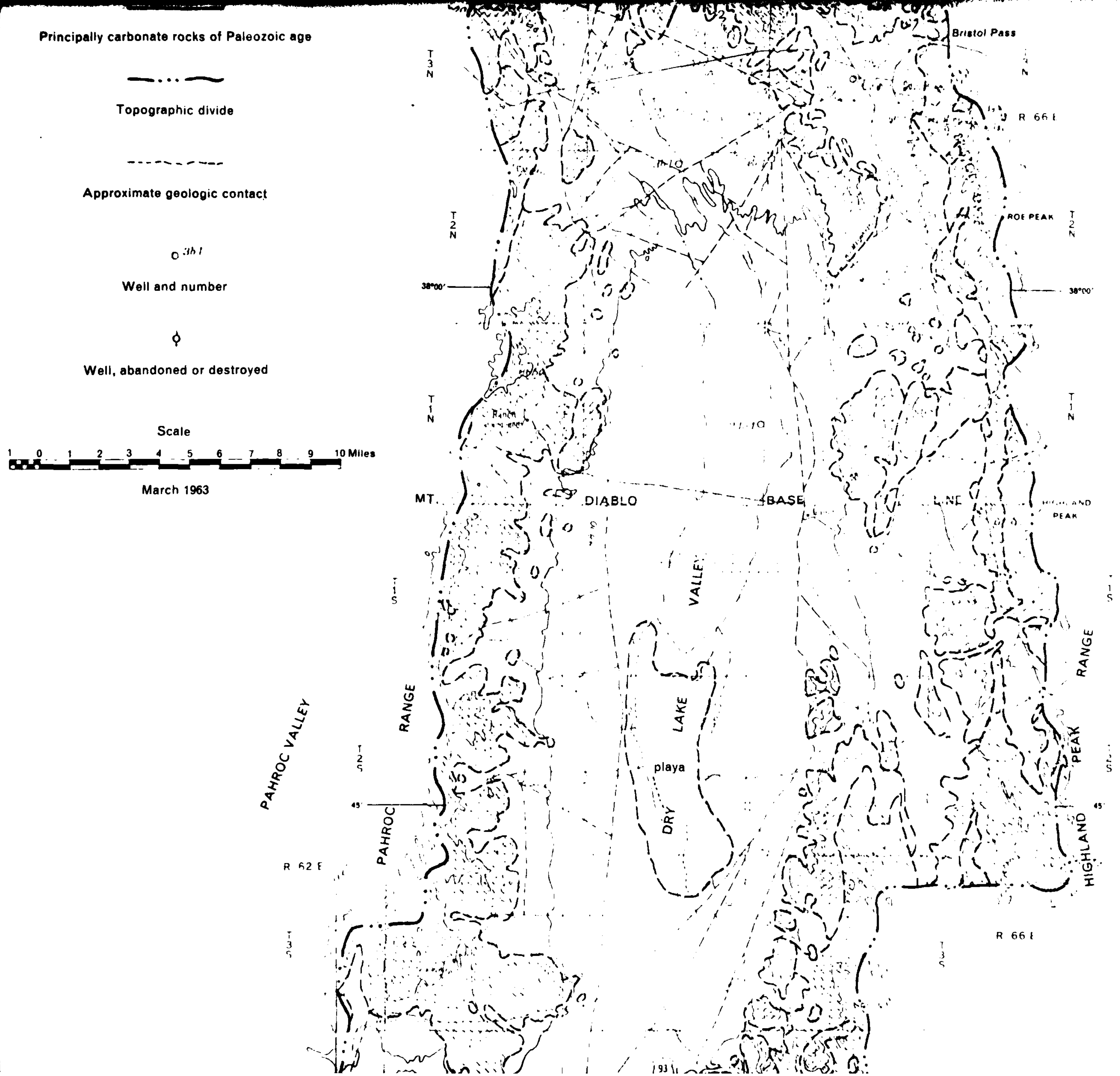
Bedrock

Principally clastic rocks of Paleozoic age and volcanic and clastic rocks of Tertiary age

Principally carbonate rocks of Paleozoic age

Topographic divide





Principally carbonate rocks of Paleozoic age
Topographic divide
Approximate geologic contact
Well and number
Well, abandoned or destroyed
Scale
1 0 1 2 3 4 5 6 7 8 9 10 Miles
March 1963
Bristol Pass
ROE PEAK
HIGHLAND PEAK
MT. DIABLO BASE LINE
VALLEY
LAKE
playa
DRY
RANGE
PEAK
HIGHLAND
PAHROC
PAHROC VALLEY
R 62 E
R 66 E
T 3 N
T 2 N
T 1 N
T 1 S
T 2 S
T 3 S
38°00'
45'

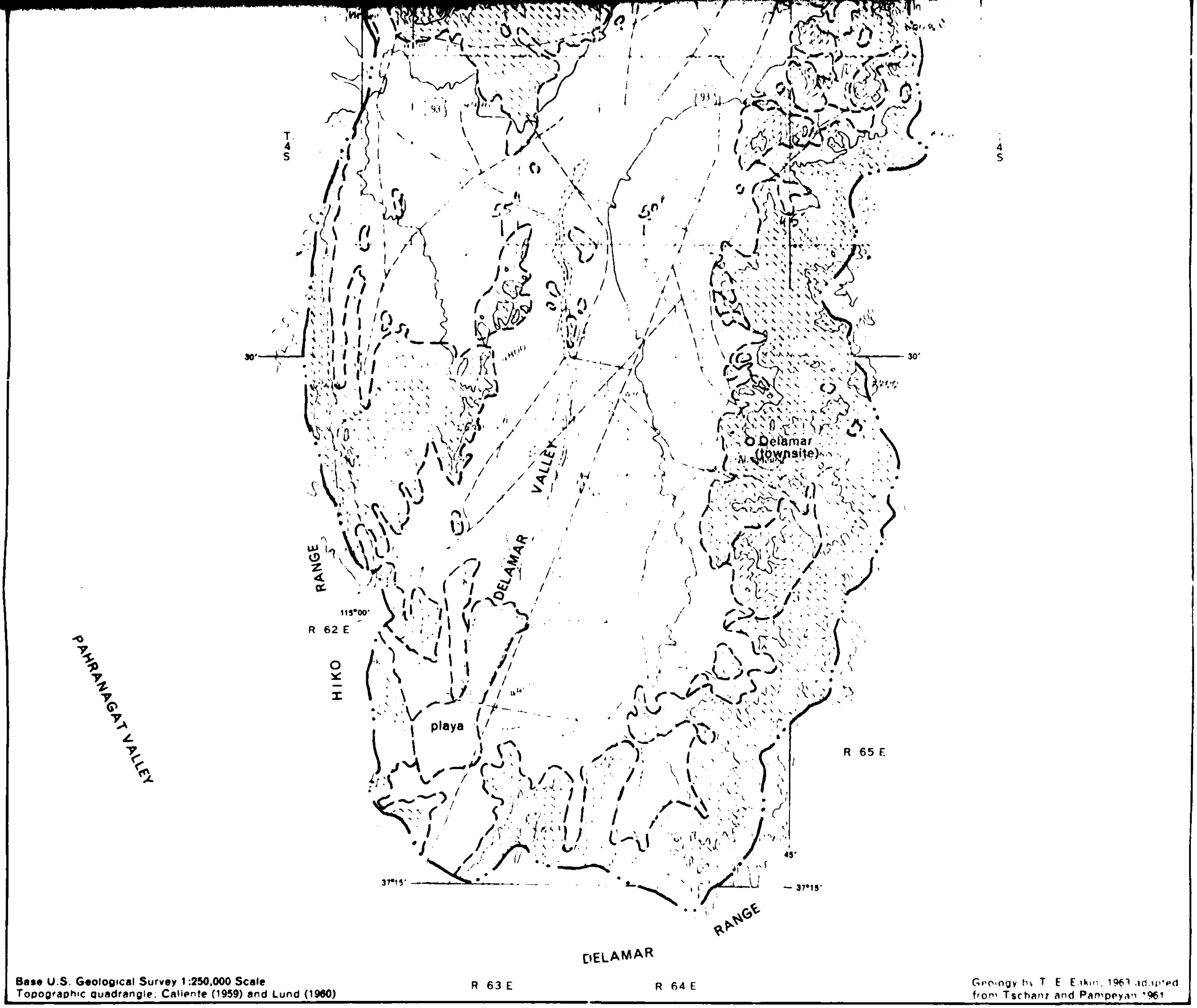


PLATE 1.—MAP OF THE DRY LAKE AND DELAMAR VALLEYS; LINCOLN COUNTY, NEVADA
SHOWING AREAS OF BEDROCK, VALLEY FILL, AND LOCATION OF WELLS

H1.0

MISCELLANEOUS WORKING DOCUMENTS

H1.1

WELL LOGS AND REPORTS TO THE
STATE ENGINEER OF NEVADA

Drylake 3N/65-21

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

(5)

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. 6895 X

Rec. Dec 4 1962

Well No.

Permit No.

Do not fill in

Owner [illegible] Driller [illegible]

Address % [illegible] Eagle Valley, Nev. Address [illegible] Lic. No. 35

Location of well: ___ ¼ ___ ¼ Sec. 21, T. 3 N/S, R 65 E, in [illegible] County Unsurveyed sec

or [illegible]

Water will be used for Stock Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 5" 50'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well November 28, 1962 Date of completion of well December 1, 1962

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	60	60	sand - gravel - boulders
60	120	60	Cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 17' to 77 ft.

Other aquifers

First water at 17 feet.

Casing perforated

from 20' to 50 ft.

Size of perforations

1/8 x 6"

Log No. [illegible]
Rec. Dec. 6 19 62
Well No. 6
Permit No.
Do not fill in

(11) (5)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner [illegible] Driller [illegible]

Address [illegible] Address [illegible] Lic. No. [illegible]

Location of well: ¼ ¼ Sec. 21, T 3 N/S, R 63 E, in [illegible] County

or [illegible]

Water will be used for Stock Total depth of well 80'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing ¼" Temp. of water

Diameter and length of casing 6" 60'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 16'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well [illegible] 21, 196[illegible] completion of well [illegible] 26, 196[illegible]

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	45	45	sand-gravel-boulders
45	50	5	sandy clay
50	80	30	cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 16' to 50'

Other aquifers

First water at 16 feet

Casing perforated

from 20' to 60

Size of perforations

½ x 12"

#11

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

31N/65-21
(4)

Log No. [illegible]
Rec. Dec 4 1962
Well No.
Permit No.
Do not fill in

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner [illegible] Driller [illegible]

Address [illegible] Address [illegible] Lic. No. 3

Location of well: ¼ ¼ Sec. 21, T. 31 N, R. 65 E, in [illegible] Co
Unsurveyed sec

or [illegible]

Water will be used for Stock Total depth of well 120'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 5" 50'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diamet

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 17'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well November 28, 1962 Date of completion of well December 1, 1962

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	60	60	sand - gravel - boulders
60	120	60	Cemented gravel

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 17' to 77'

Other aquifers

First water at 17 feet.

Casing perforated

from 30' to 50'

Size of perforations

⅛ x 1½

(OVER)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA 30/65-21

(6) dcb

Log No.	
Rec.	Dec 11 1959
Well No.	
Permit No.	

Do not fill in

Owner Albert Delmue Driller Darell Free

Address Pioche, Nevada Address Pioche, Nevada Lic. No. 30

Location of well: ___ ¼ ___ ¼ Sec. ___, T ___ N/S, R ___ E, in Lincoln County

or Bristol Wells

Water will be used for Stock Total depth of well 79'

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 10 gauge Temp. of water

Diameter and length of casing 7" 80'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 23'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well December 3, 1959 Date of completion of well December 9, 1959

Type of well rig Churn Drill

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	12	12	gravel
12	18	6	boulders
18	79	61	Cemented gravel very hard + tight

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 46 to 79 ft.

Other aquifers

First water at 46 feet

Casing perforated

from 44 to 80 ft.

Size of perforations

1/8 x 12'

919

5N/65-22.

Log No. 1070~x
Rec. 19
Well No.
Permit No. 23978
Do not fill in BASIN

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Dry Lake

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner Sideys Driller [illegible]

Address Address [illegible] Lic. No.

Location of well ¼ ¼ Sec. 29, T. N/S, R. E, in [illegible] Co.

or

Water will be used for Irragation Total depth of well 240

Size of drilled hole 24" Weight of casing per linear foot

Thickness of casing 1/4 Temp. of water

Diameter and length of casing 14" 240'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diamet

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 3'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well 1/1/66 Date of completion of well 2/1/66

Type of well rig Rotary

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	15	15	Soil
15	25	4	Gravel Sand
25	34	11	Clay Gravle
34	52		Clay
52	56		Gravle Sand
56	75		Clay
75	94		Gravel Sand
94	103		Clay
123	123		Sand
123	129		Clay
129	134		Sand Gravle
134	144		Clay
144	147		Sand
147	159		Sand Gravle
[illegible]	1[illegible]		Boulder Clay
[illegible]	[illegible]		Sand Gravel
[illegible]	[illegible]		Clay
[illegible]	[illegible]		[illegible]
[illegible]	203		[illegible]
230	2[illegible]		[illegible]
	[illegible]		[illegible] Clay

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)

from 60 to 240 ft

Other aquifers

First water at 18 feet.

Casing perforated

from 60 to 240

Size of perforations

3/8

913

2

To feet	Thickness	Type of material

CASING RECORD

[..]m. [..]ing	From feet	To feet	Length	"Remarks"—Seals, Grouting, Etc.

GENERAL INFORMATION—Pumping Test, Quality of Water, Etc.

....

....

....

....

....

WELL DRILLER'S STATEMENT

[..]vell was drilled under my jurisdiction and the information is true to my best information and [..]f.

Signed..
Well Driller

By..

License No..................................

...., 19..........

(Not to be filled in by Driller)

....

....

1969 AUG 15 AM 10 11

STATE ENGINEER
OFFICE

....

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

#5

1N/64E-39

(20)

Log No. [illegible]
Basin [illegible]
Well No. [illegible]
Permit No. 17758

Owner Lyle Hollinger — Delmar [illegible] Driller Basil Frei
Address Pioche, Nevada Address Box 1 - Pioche, Nevada License No. 30
Location of well: [illegible] Sec. 39 T1N R64E in Lincoln County
or Simpson Junction area
Water will be used for Stock Total depth of well 515
Size of drilled hole 7 1/4" Weight of casing per linear foot
Thickness of casing 3/16" Temp. of water
Diameter and length of casing 5" 515'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter)
If flowing well give flow in c.f.s. or g.p.m. and pressure
If nonflowing well give depth of standing water from surface 398' TO WATER.
If flowing well describe control works
(Type and size of valve, etc.)
Date of commencement of well Dec. 15, 1958 Date of completion of well Jan. 17, 1959
Type of well rig Cable Drill

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	3	3	clay
3	15	12	sandy gravel
15	60	45	Clay
60	350	290	stratified sand & gravel
350	420	70	fine sand
420	428	8	Cemented lime
428	515	87	Clay

Water-bearing Formation, Casing Perforations, Etc.

CHIEF AQUIFER WATER BEARING
Chief aquifer (water-bearing formation)

From 428 to 515 ft.

Other aquifers

FIRST WATER AT 428 Feet
First water at 428 feet

Casing perforated
Casing perforated

From 420 to 515 ft.

Size of perforations
1/8 x 10" 1/8" x 10" SLOT SIZE.

(32- 35/63-22db

(43)

WELL ... T TO THE STATE ENGI... ER
... NEVADA
... THIS FORM IN ITS ENTIRETY

Log No. 10064
Rec. ... 19...
Well No. ...
Permit No. 22477
Do not fill in.

Owner CH... ...OSKROW Driller VICK McCANN
Address ... NEVADA Address BEAVER Lic. No. 2381
Location of well ... 22 ... T. 3 3½ S., R. 63 E., in Lincoln Co.
Permit No. ... 51 22477
Water will be used for ... ATION Total depth of well
Size of drilled hole ... Weight of casing per linear foot
Thickness of casing ... GAGE Temp. of water
Diameter and length of ... 230"
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)
If flowing well give flow ... g.p.m. and pressure 3' 4"
If nonflowing well give d... ding water from surface
If flowing well describe c... ls
(Type and size of valve, etc.)
Date of commencement ... 1/13/66 Date of completion of well 3/2/66
Type of well rig ...

... FORMATIONS

From feet	To feet		Type of material
0	8	8	GREY CLAY
8	12	4	BLUE CLAY
12	1..		GREY CLAY
125	132		GRAVEL
132	138		CLAY
138	155		GRAVEL
155	168		CLAY
168	174		GRAVEL
174	175		CLAY
177	190		SANDY CLAY
190	205		GRAVEL
205	207		SAND
207	222		SAND + GRAVEL
222	230		CLAY

Water-bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)
from 125 to 230'

Other aquifers

First water at 8 feet.

Casing perforated
from 60 to 230

Size of perforations
3/8

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

Observation Well

STATE OF NEVADA
DIVISION OF WATER RESOURCES

3S/64E-12ac

M Gemmell
9-15-81

WELL DRILLERS REPORT

Please complete this form in its entirety

OFFICE USE ONLY
Log No ...
Permit No. ...
Basin ...

1. OWNER U.S. DEPT OF THE AIR FORCE ADDRESS Norton AFB, Calif. 92409
Ballistics Missile Office

2. LOCATION NE ¼ SW ¼ Sec. 12 T. 3 N/S R. 64 E. Nye County
PERMIT NO. none req. Exploratory well

3. TYPE OF WORK
New Well ☒ Reconditio ☐
Deepen ☐ Other ☐

4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL
Cable ☐ Reverse Rotary ☒
Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
fine sand, some small rock		0	50 ft.	
sand and gravel		50	185	
gravel, coarse sand		185	240	
gravel, corse sand, some clay		240	275	
gravel, sand, some silt		275	340	
coarse sand, gravel, traces of silt and clay		340	370	
gravel with sand and silt and 1/2" rock		370	420	
sand, gravel, trace of silt & clay, rock from 1/2" to 3"		420	510	
gravel and coarse sand		510	610	
gravel, sand, small rock 1/2" to 2" and silt		610	1010	
sand, gravel streaks with rocks up to 6" size		1010	1300	

Date started December 20, 19 79
Date completed January 26, 19 80

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump
air lift	15 ±		4

not applicable

BAILER TEST
G.P.M. ... Draw down ... feet ... hours
G.P.M. ... Draw down ... feet ... hours
G.P.M. ... Draw down ... feet ... hours

8. WELL CONSTRUCTION
Diameter hole 18-5/8" inches Total depth 1300 feet
Casing record ...
Weight per foot ... Thickness ...

Diameter	From	To
2 inches	0 feet	1300 feet
2 inches	0 feet	798 feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☒ No ☐ Type grout
Depth of seal 40 ft. feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 0 feet to 1300 feet

Perforations:
Type perforation mill slot
Size perforation ...
From 1270 feet to 1290 feet
From 768 feet to 788 feet
From ... feet to ... feet
From ... feet to ... feet
From ... feet to ... feet

9. WATER LEVEL
Static water level 383 Feet below land surface
Flow ... G.P.M.
Water temperature cold ° F. Quality ...

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC. (James L. Clyde Driller
Address 591 S.Walnut Street-La Habra, Ca.9063
Nevada contractor's license number 007055A
Nevada driller's license number 1169
Signed John K. Beylik
Date Feb. 12, 1980

USE ADDITIONAL SHEETS IF NECESSARY

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

STATE OF NEVADA
DIVISION OF WATER RESOUR S

OFFICE USE ONLY
Log No. ....
Permit No ....
Basin ....

35/64E-12ac

WELL DRILLERS REPORT

Please complete this form in its entirety

9-15-81 Pumping Well

1. OWNER U. S. DEPT. OF THE AIRFORCE ADDRESS Norton AFB, Calif. 92409
Ballistic Missile Dept.
(Well is: Dry Lake Valley Test Well No. TW-1)

2. LOCATION NE 1/4 SW 1/4 Sec. 12 T. 3S N/S R. 64E E. in Lincoln County
PERMIT NO. none required - Exploratory hole

3. TYPE OF WORK
New Well ☒ Recondition ☐
Deepen ☐ Other ☐

4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL
Cable ☐ Rotary ☐
Other ☒ Reverse ~~Circulation~~

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
gravel, clay, small rock		0	140	
gravel, small rock		140	150	
large rocks, 2" dia. gravel and fine sand		150	190	
large rocks, 2" dia. gravel		190	260	
gravel & small 1" dia. rocks		260	370	
fine sand & few small rocks		370	400	
gravel & small rocks/clay		400	440	
brown clay, small amt. gravel		440	520	
gravel and small rocks		520	600	
gravel, very little clay		600	630	
brown clay, small rocks		630	710	
gravel		710	760	
brown clay and gravel		760	780	
gravel and fine sand		780	800	
gravel, very little clay		800	830	
gravel & small rocks		830	850	
gravel, some small rocks		850	880	
small 1" dia. rocks, gravel		880	900	
rocks & gravel		900	1000	
gravel		1000	1005	
hard rock and some gravel		1005	1010	

Date started Feb. 6th, 19 80
Date completed April 20th, 19 80

7. WELL TEST DATA

Pump RPM	G P M	Draw Down	After Hours Pump
1800	500	41	70

BAILER TEST
None None
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours

8. WELL CONSTRUCTION
Diameter hole 18-1/2 inches Total depth 1,000 feet
Casing record ....
Weight per foot .... Thickness 5/16"

Diameter	From	To
22" x 1/4" wall inches	0 feet	40 feet
16 x 5/16" inches	+ 2 feet	1000 feet

Surface seal: Yes ☒ No ☐ Type grout
Depth of seal 40 ft. feet
Gravel packed: Yes ☒ No ☐
Gravel packed from 10 feet to 1000 feet

Perforations:
Type perforation Johnson wire screen
Size perforation .050
From 970 feet to 950 feet
From 920 feet to 900 feet
From 870 feet to 850 feet
From 830 feet to 810 feet
From 770 feet to 750 feet
From 720 feet to 700 feet
From 670 feet to 650 feet
From 620 feet to 600 feet

9. WATER LEVEL
Static water level 422 Feet below land surface
Flow .... G.P.M.
Water temperature 82.5 ° F. Quality slightly cloudy

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name BEYLIK DRILLING, INC.
Address 591 S. Walnut Street
La Habra, Calif. 90631
Nevada contractor's license number 007055A
Nevada driller's license number 1168 and 1169
Signed James L. Clyde (James Clyde) Driller
Date April 21, 1980

USE ADDITIONAL SHEETS IF NECESSARY

WELL LOG AN[illegible] [illegible]ORT TO THE STATE EN[illegible] [illegible]

OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Log No. [illegible]
Rec. [illegible] 19
Well No.
Permit No. 22559
Do not fill in.

Owner [illegible] Driller [illegible]

Address 350 [illegible] Address [illegible] Lic. No. [illegible]

Location of well: SE 1/4 SE 1/4 Sec. 23, T. 4 N/S, R. 63 E, in [illegible]

Permit No. [illegible]

Water will be used for Irrigation Total depth of well 61'

Size of drilled hole 16" Weight of casing per linear foot

Thickness of casing [illegible] Temp. of water

Diameter and length of casing

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface

If flowing well describe control works

(Type and size of valve, etc.)

Date of commencement of well [illegible] 17, 1966 Date of completion of well [illegible] 19, 196[illegible]

Type of well rig [illegible]

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	5	5	soil
5	12	7	sand
12	51	39	Cemented gravel
51	61	10	gravel in boulders

Water-bearing Formation, Casi[ng] Perforations, etc.

Chief aquifer (water-bearing form[ation])

from ... to ...

Other aquifers

First water at ... f[t].

Casing perforated

from ... to ...

Size of perforations

(34) 4-0163-4·CD

#2

5

Log No. 9636
Rec. Aug 8
Well No.
Permit No. 22855
Do not fill in.

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

L 1051

Owner [illegible] Driller [illegible]

Address 350 [illegible] Address [illegible] Lic. No. 30

Location of well: S.E.¼ S.W.¼ Sec. 24, T. 4 N/S, R. 63 E, in Lincoln

Permit No. [illegible]

Water will be used for test [illegible] Total depth of well 360'

Size of drilled hole 7¼" Weight of casing per linear foot

Thickness of casing no Casing Temp. of water

Diameter and length of casing
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface no water

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well July 24, 1967 Date of completion of well July 29, 1967

Type of well rig Cable Tool

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
~~0~~	~~65~~	~~65~~	~~drilled in 1966~~
65	226	161	Cemented sand
226	228	2	Clay
228	236	8	Cemented sand
236	238	2	Clay
238	240	2	Cemented sand
240	250	10	clay with layers of sand
250	252	2	Cemented boulders
252	296	44	Layers of cemented sand in sand
296	297	1	Clay
297	326	29	Layers of cemented sand in sand
326	327	1	Clay
327	360	33	sand

Water-Bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)

from .... to ....

Other aquifers

First water at .... feet

Casing perforated

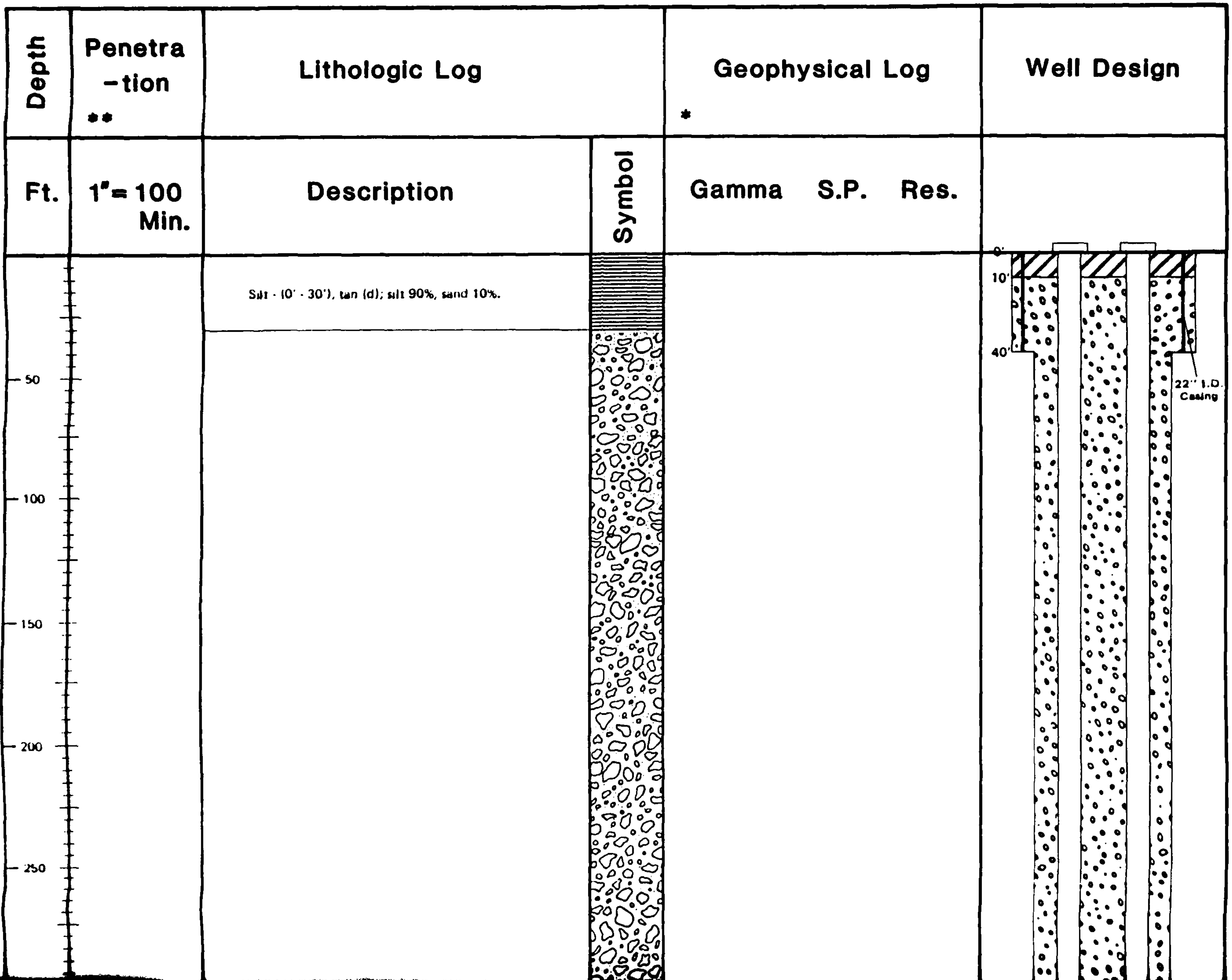
from .... to ....

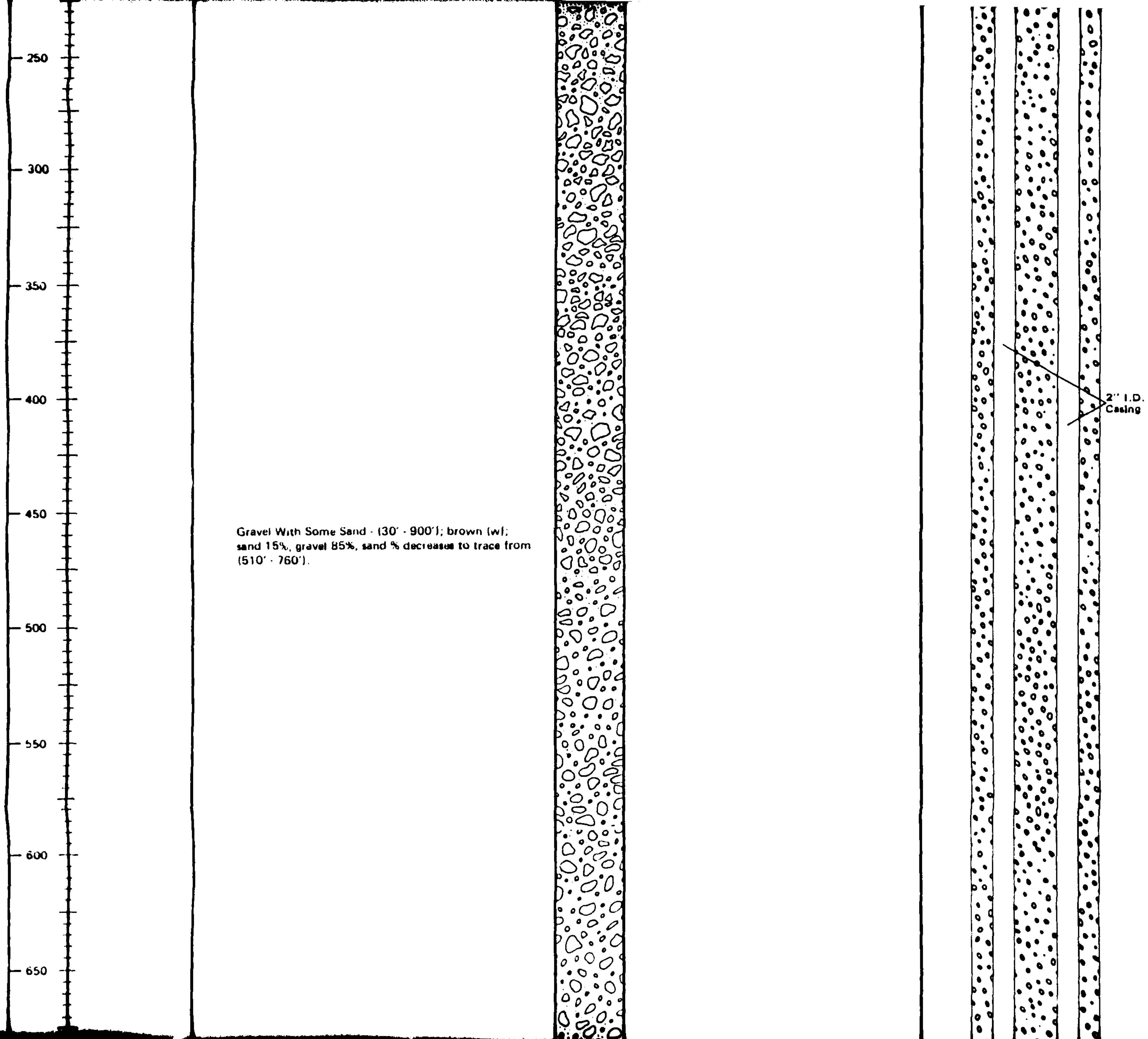
Size of perforations

H1.2

DRY LAKE VALLEY WELL LOG
AND WELL DESIGN (VALLEY-FILL)

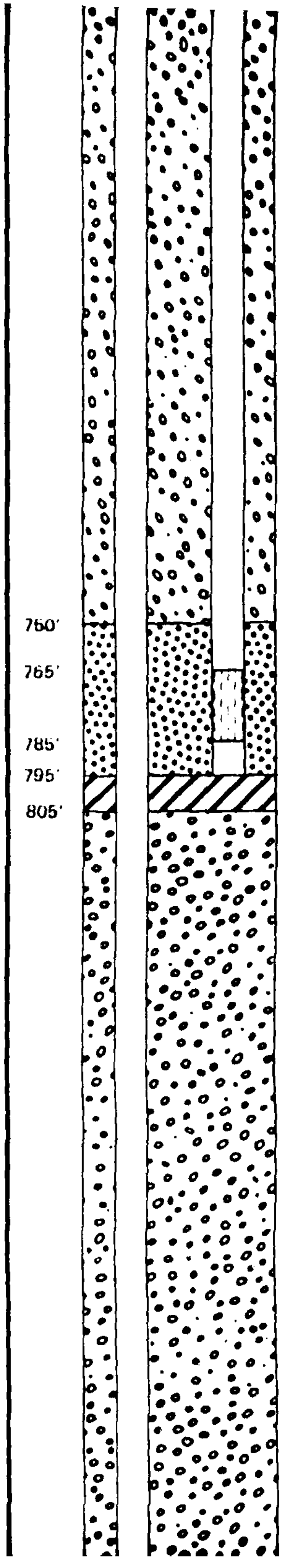
DRY LAKE VALLEY OBSERVATION WELL (DL-I-O-1) 3S/64E-12da

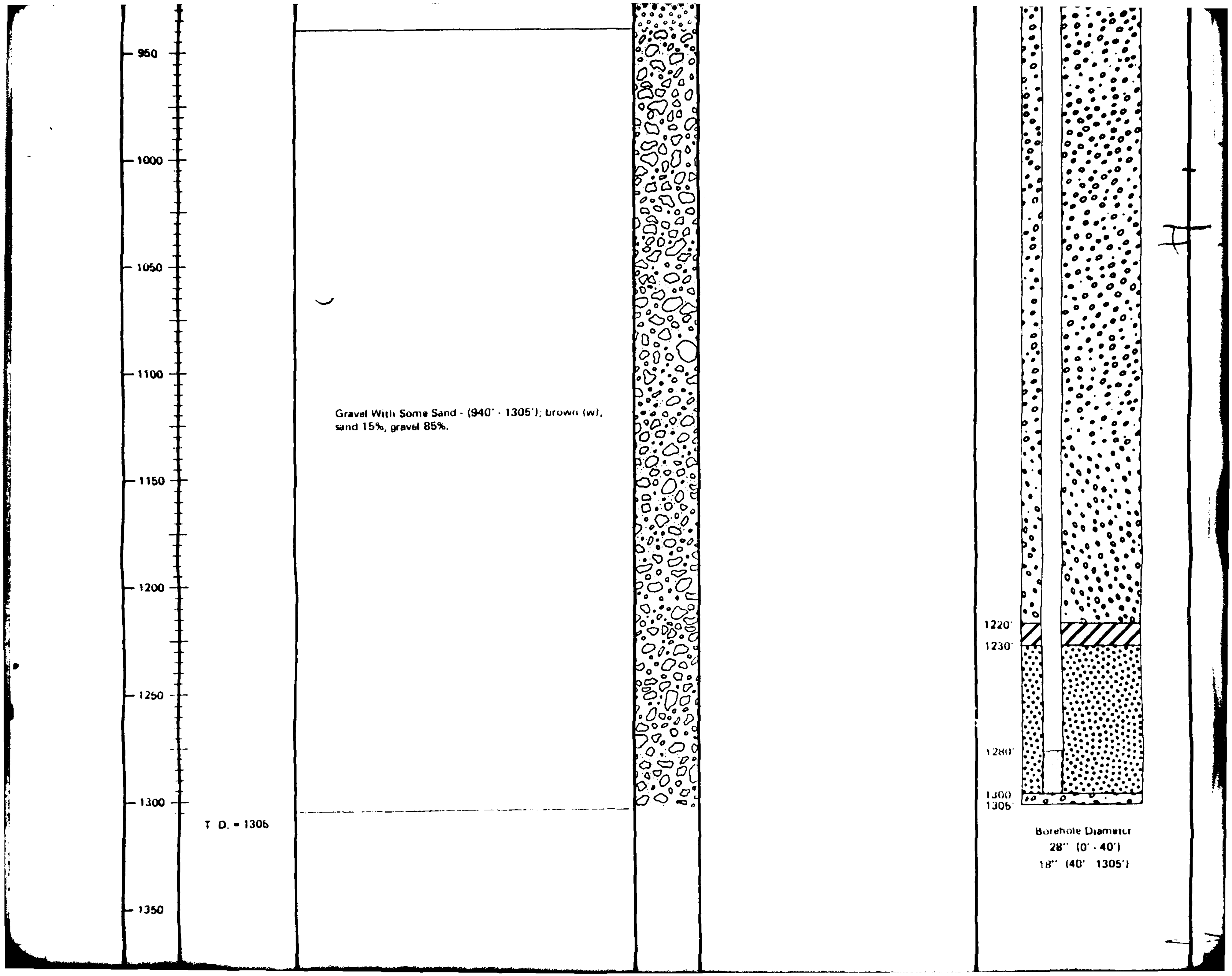



250
300
350
400
450
500
550
600
650
Gravel With Some Sand - (30' - 900'); brown (w); sand 15%, gravel 85%, sand % decreases to trace from (510' - 760').
2" I.D. Casing

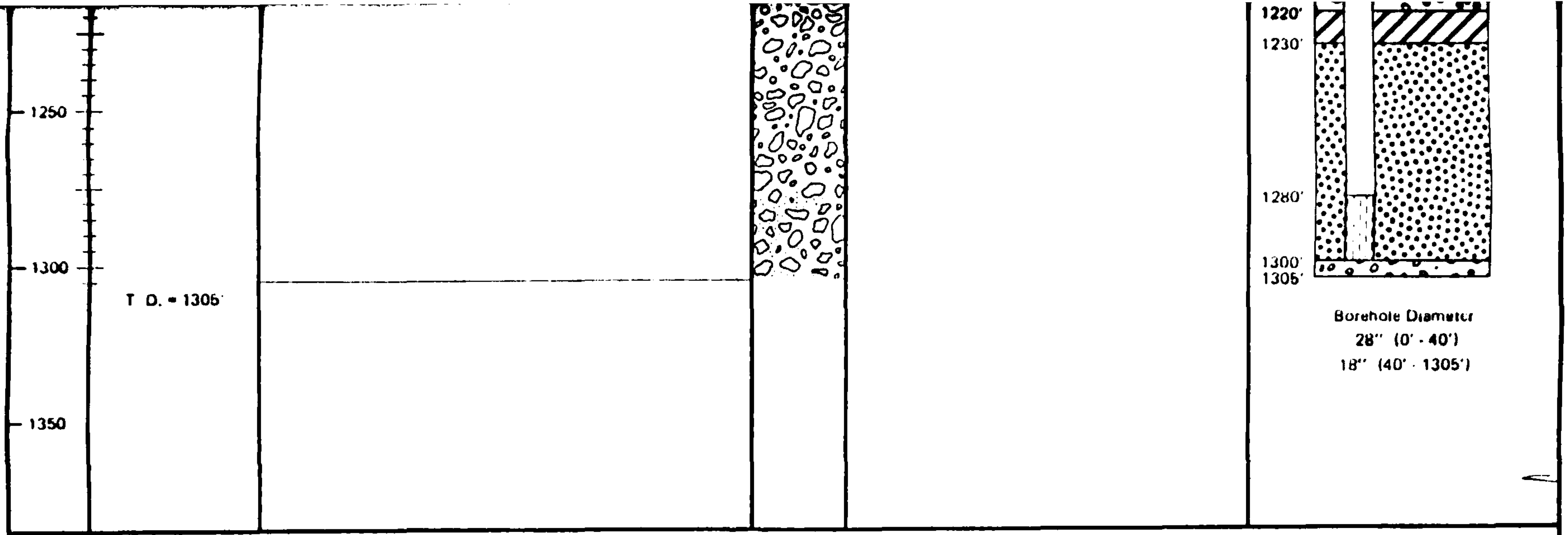
600
650
700
750
800
850
900
950
1000

Sand With Some Gravel And Silt - (900' - 940'), brown (w), sand 70%, gravel 20%, silt 10%.





950
1000
1050
1100
1150
1200
1250
1300
1350
T. D. = 1306
Gravel With Some Sand - (940' - 1305'); brown (w), sand 15%, gravel 85%.
1220'
1230'
1280'
1300
1306'
Borehole Diameter
28" (0' - 40')
18" (40' 1305')



LITHOLOGIC SYMBOLS

Clay
Clay Silt
Silt
Silt And Clay
(May also include modifiers of: with some gravel, and with very little gravel).

Sand With Gravel
Silt And Sand With Gravel
Silty Sand With Gravel
(May also include the modifier: and gravel).

Gravel With Sand
Gravel With Clay Sand
Gravel With Silty Clay Sand
Gravel With Silty Sand
Gravel With Clay And Sand
Gravel With Silt And Sand
(May also include modifiers of with some, and with very little).

* Geophysical logs not applicable for this format.

** Penetration rates were not recorded.

WELL DESIGN

Cement

Pea Gravel

Well Pack

Slotted Pipe

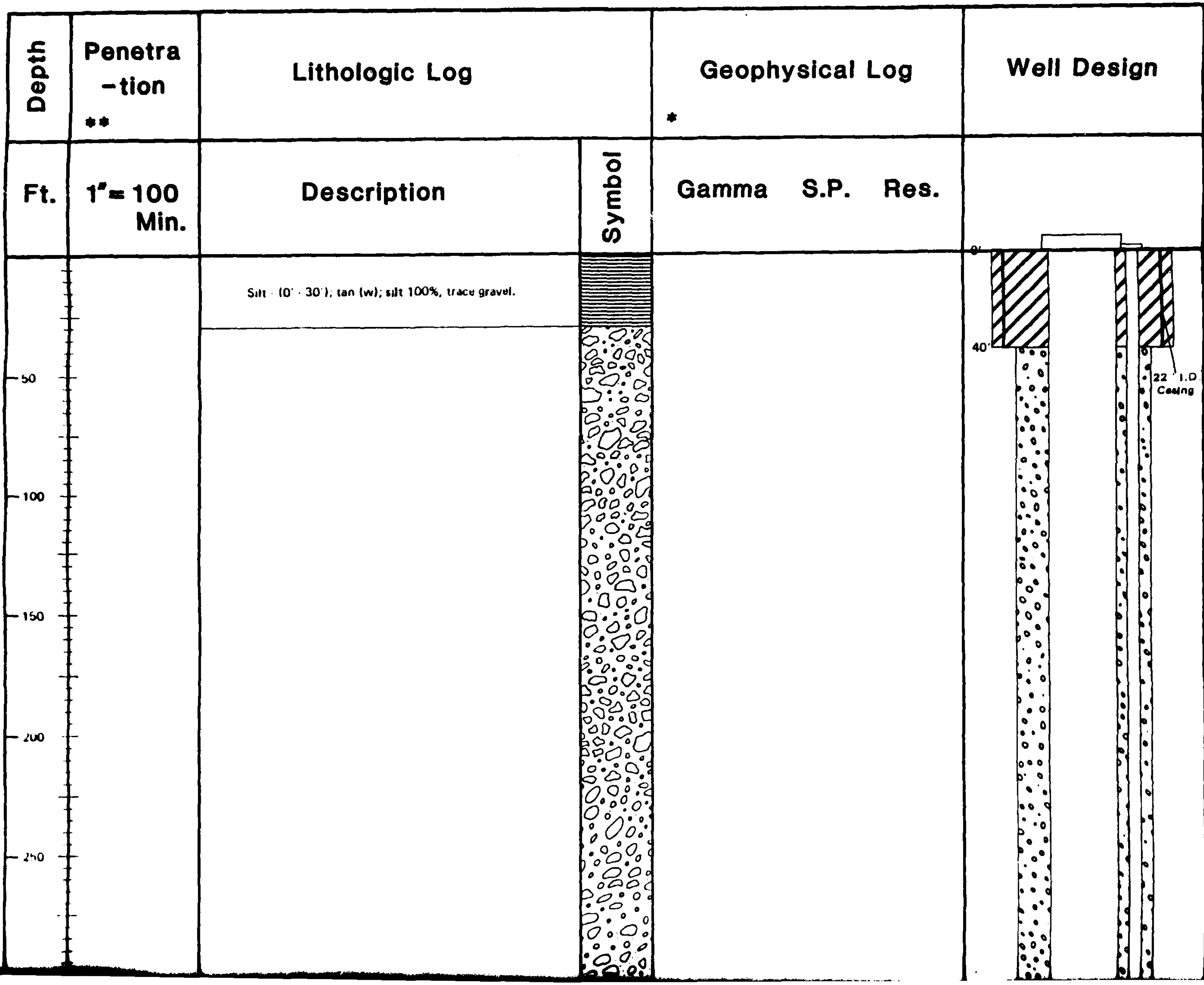
DRY LAKE VALLEY
(DL-I-O-1)

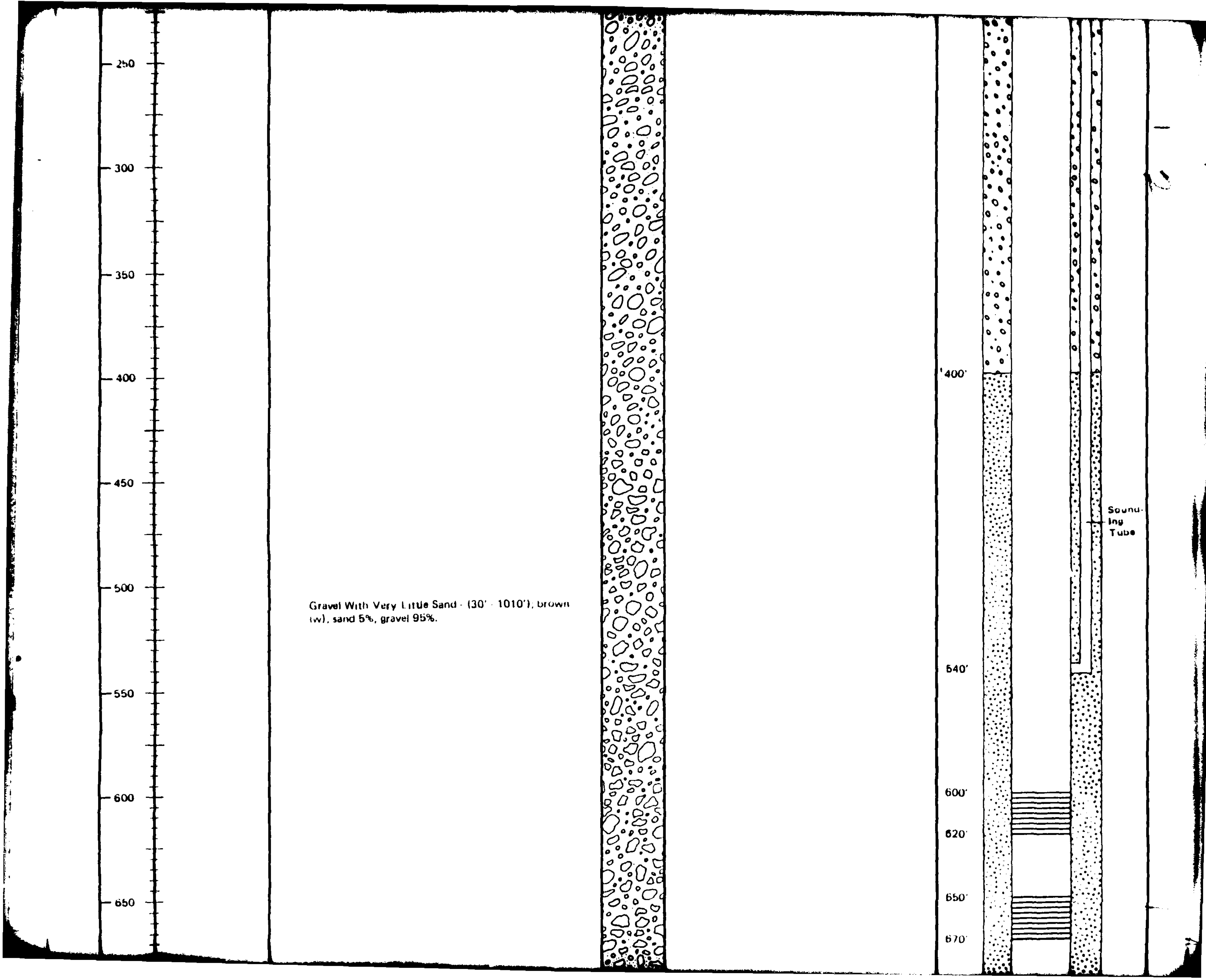
MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

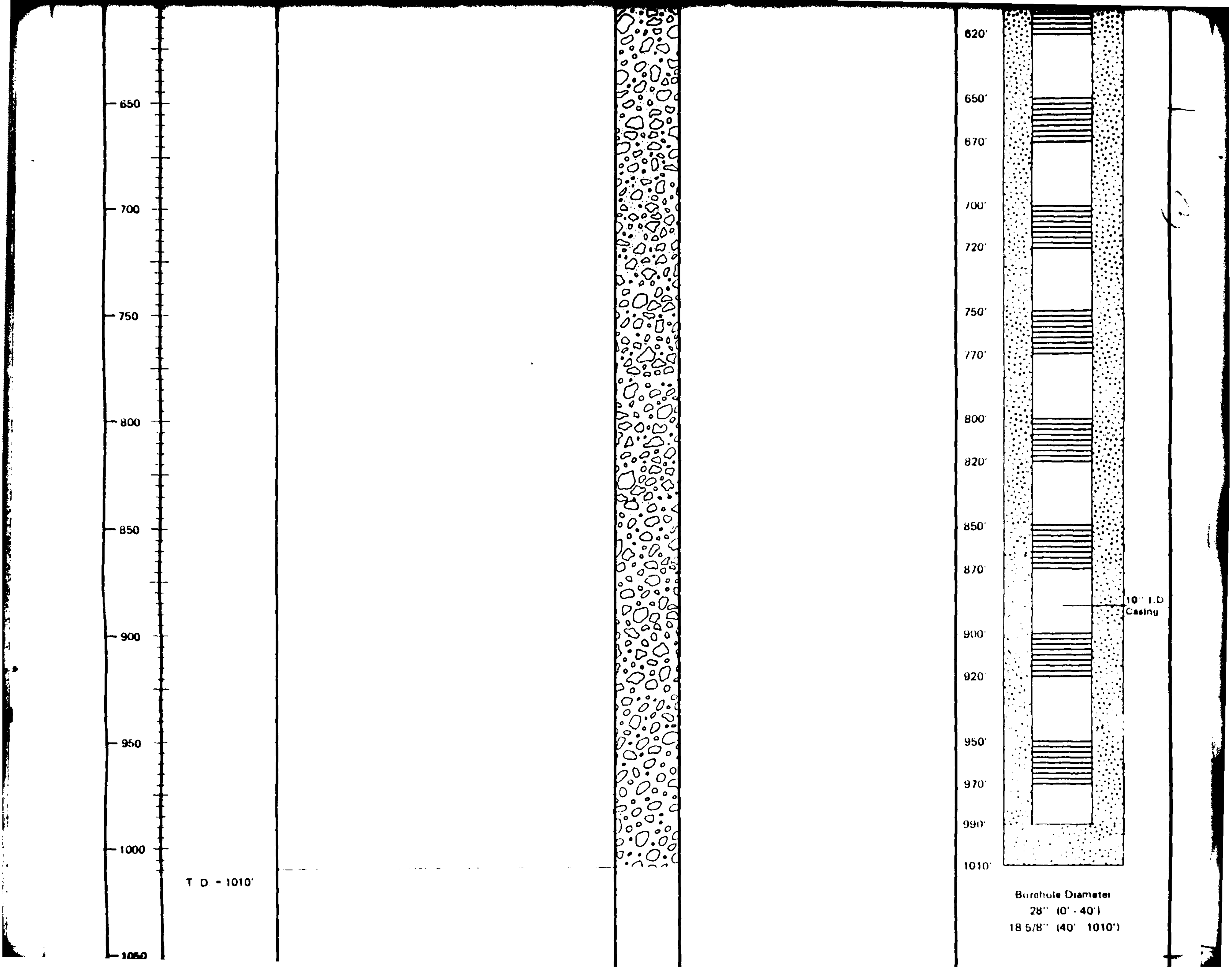
FIGUR

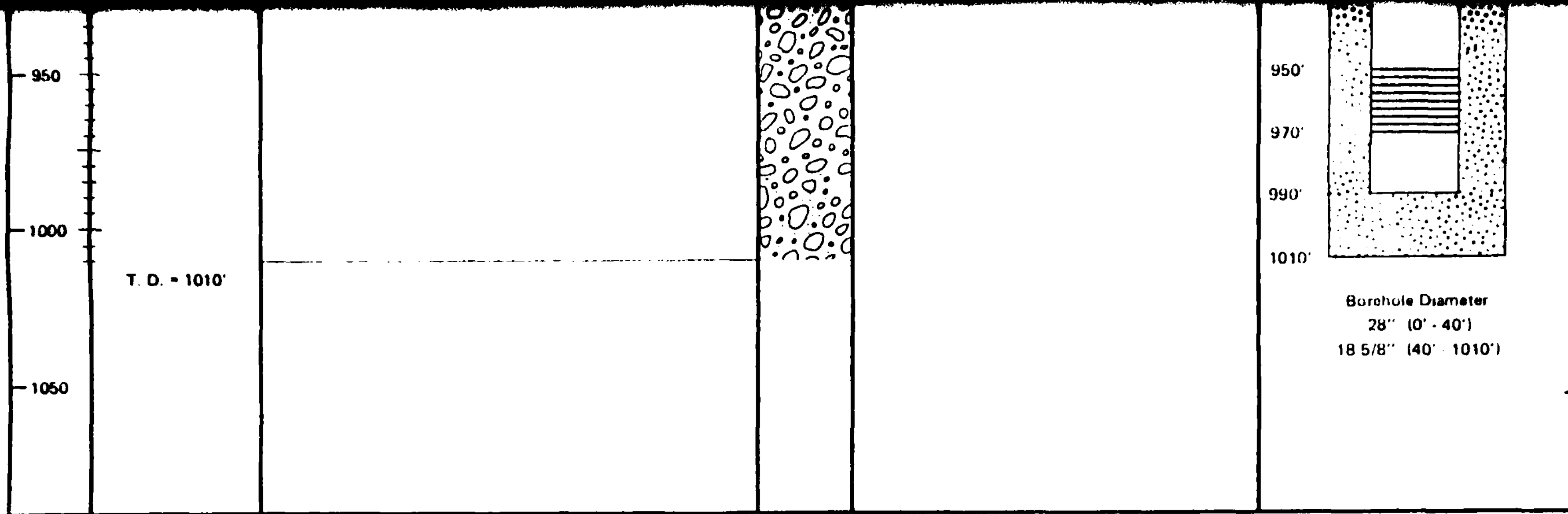
FUGRO NATIONAL, INC

DRY LAKE VALLEY TEST WELL (DL-I-T-1) 3S/64E-12da




250
300
350
400
450
500
550
600
650
Gravel With Very Little Sand - (30' - 1010'); brown (w), sand 5%, gravel 95%.
400'
540'
600'
620'
650'
670'
Sounding Tube


650
700
750
800
850
900
950
1000
1050
T D = 1010'
620'
650'
670'
700'
720'
750'
770'
800'
820'
850'
870'
10" I.D
Casing
900'
920
950'
970'
990'
1010'
Borehole Diameter
28" (0' - 40')
18 5/8" (40' 1010')



4

LITHOLOGIC SYMBOLS

Clay
Clay Silt
Silt
Silt And Clay
(May also include modifiers of: with some gravel, and with very little gravel).

Gravel With Sand
Gravel With Clay Sand
Gravel With Silty Clay Sand
Gravel With Silty Sand
Gravel With Clay And Sand
Gravel With Silt And Sand
(May also include modifiers of, with some, and with very little).

WELL DESIGN

Cement

8 - 12 Sand

Pea Gravel

Screen

* Geophysical logs not applicable for this format.

** Penetration rates were not recorded.

DRY LAKE VALLEY
(DL-I-T-1)

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE - BMO

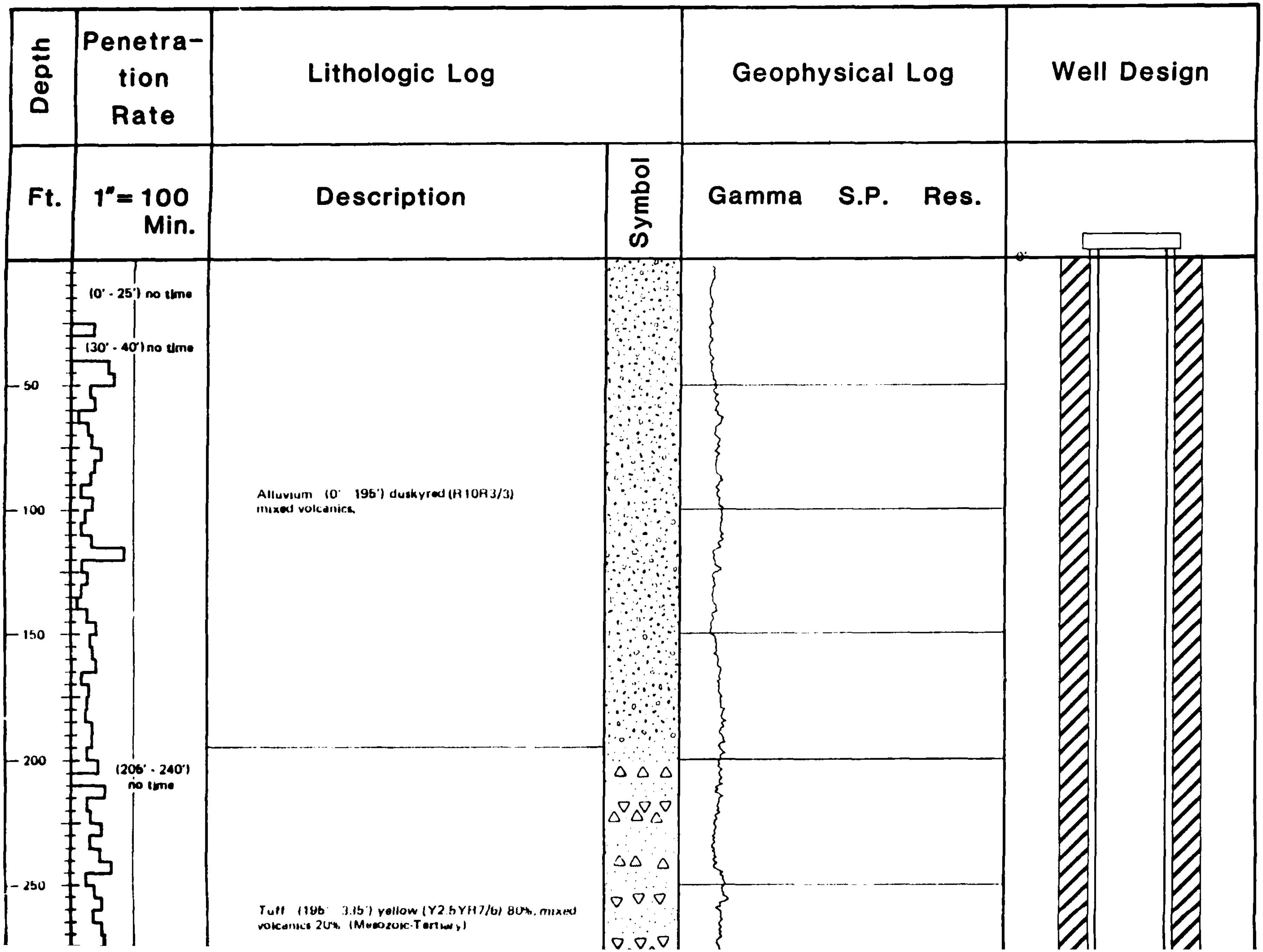
FIGURE

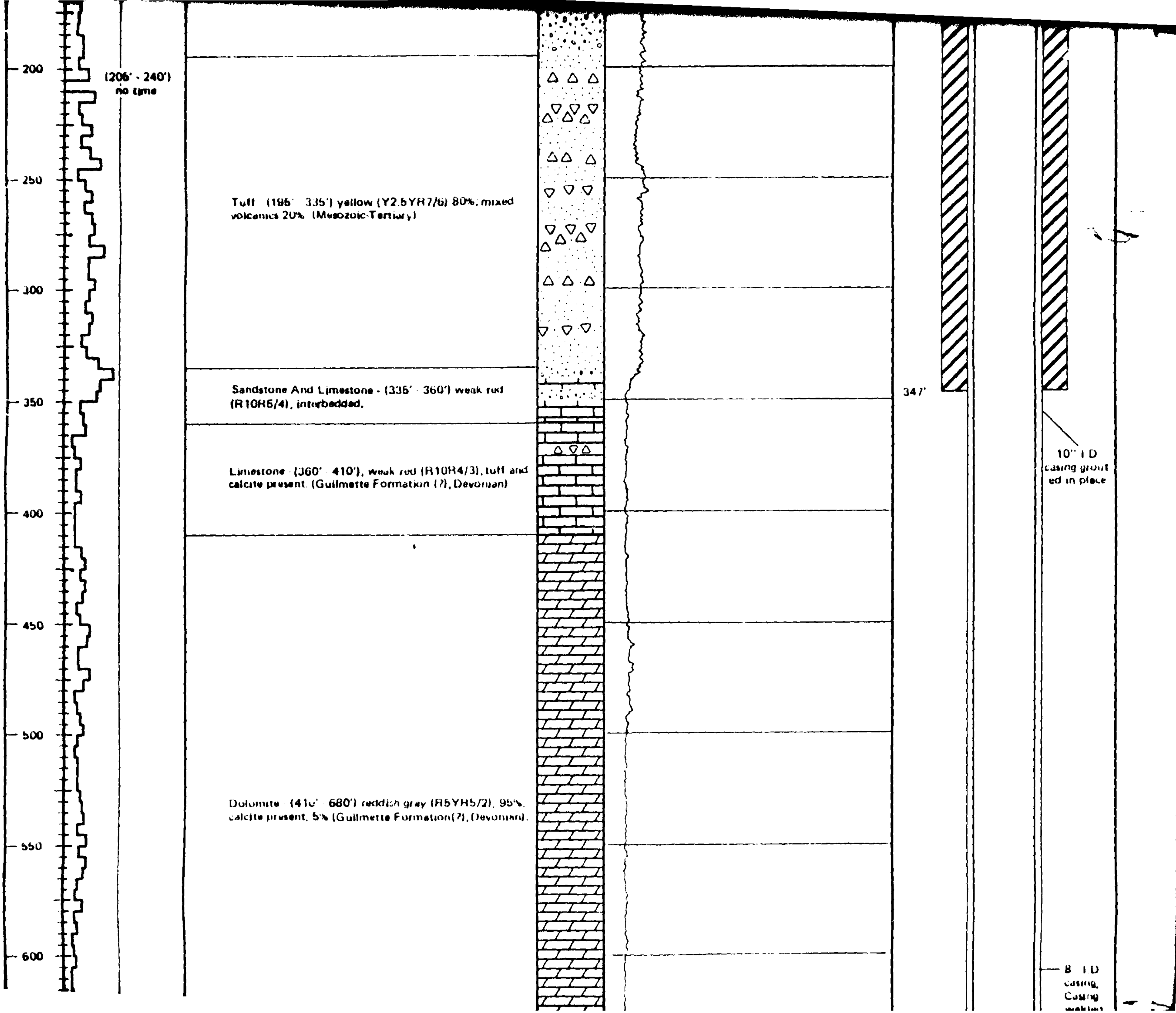
FUGRO NATIONAL, INC.

H1.3

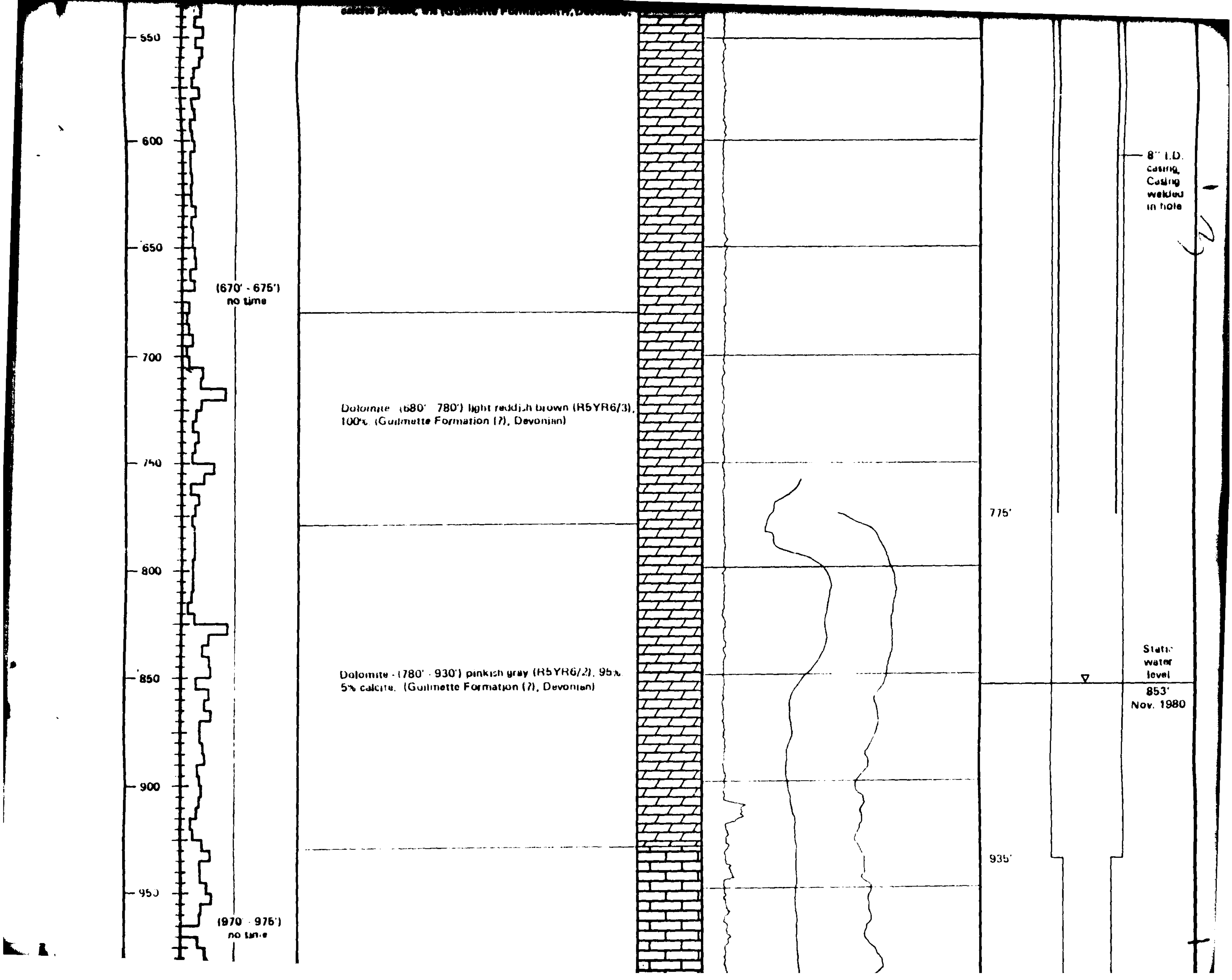
DRY LAKE VALLEY WELL LOG
AND WELL DESIGN (CARBONATE)

DRY LAKE VALLEY TEST WELL 3N/63E-27ca

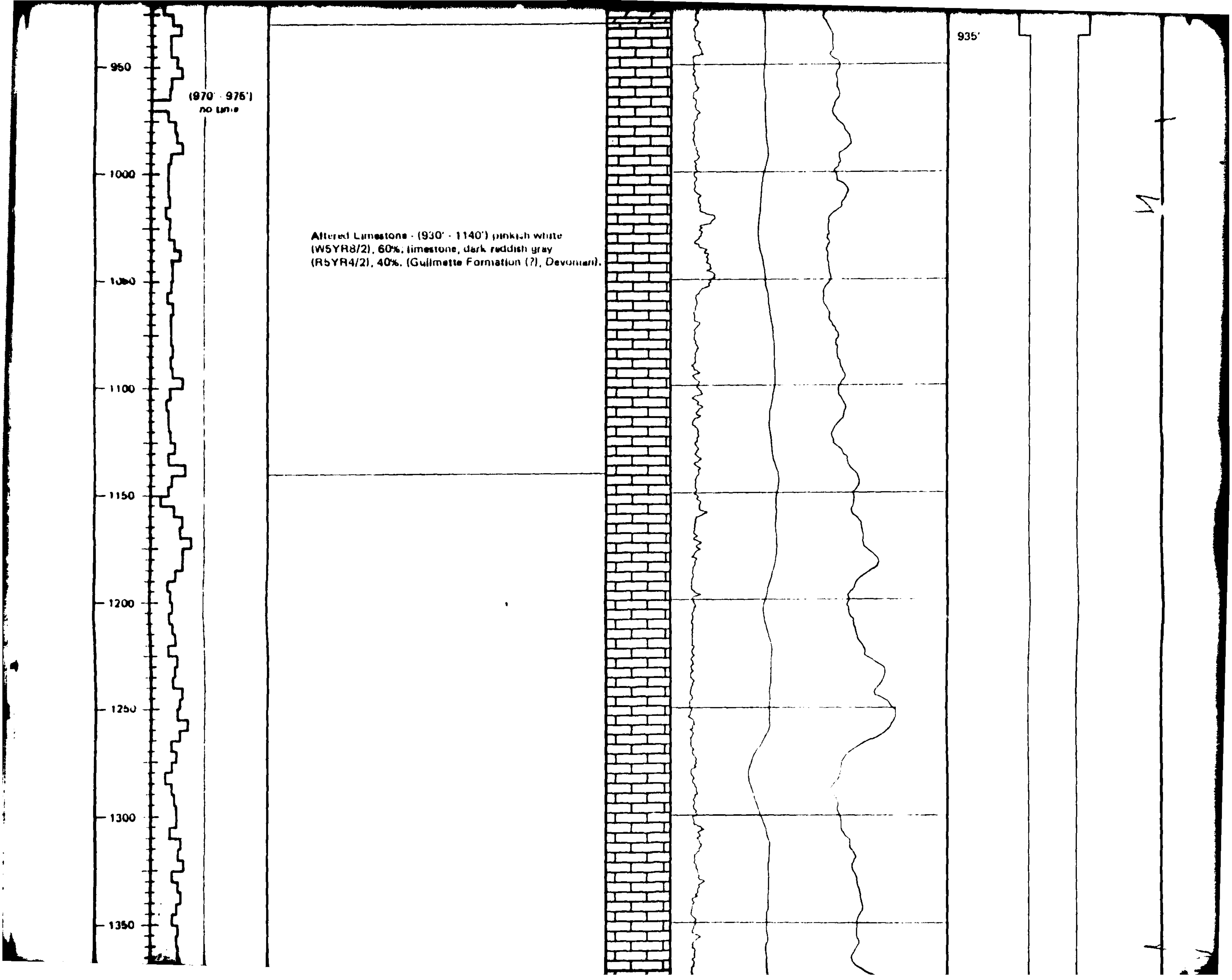


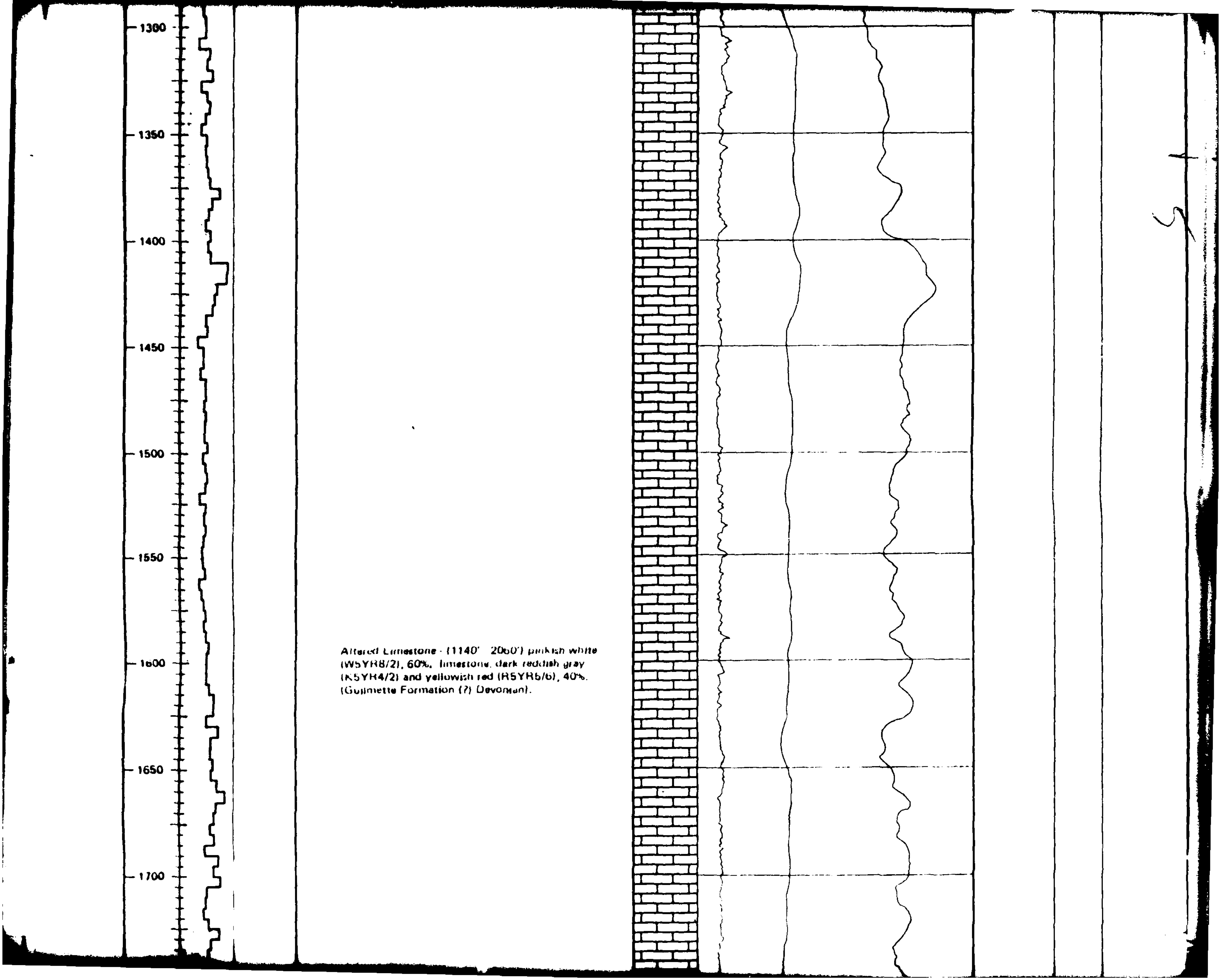


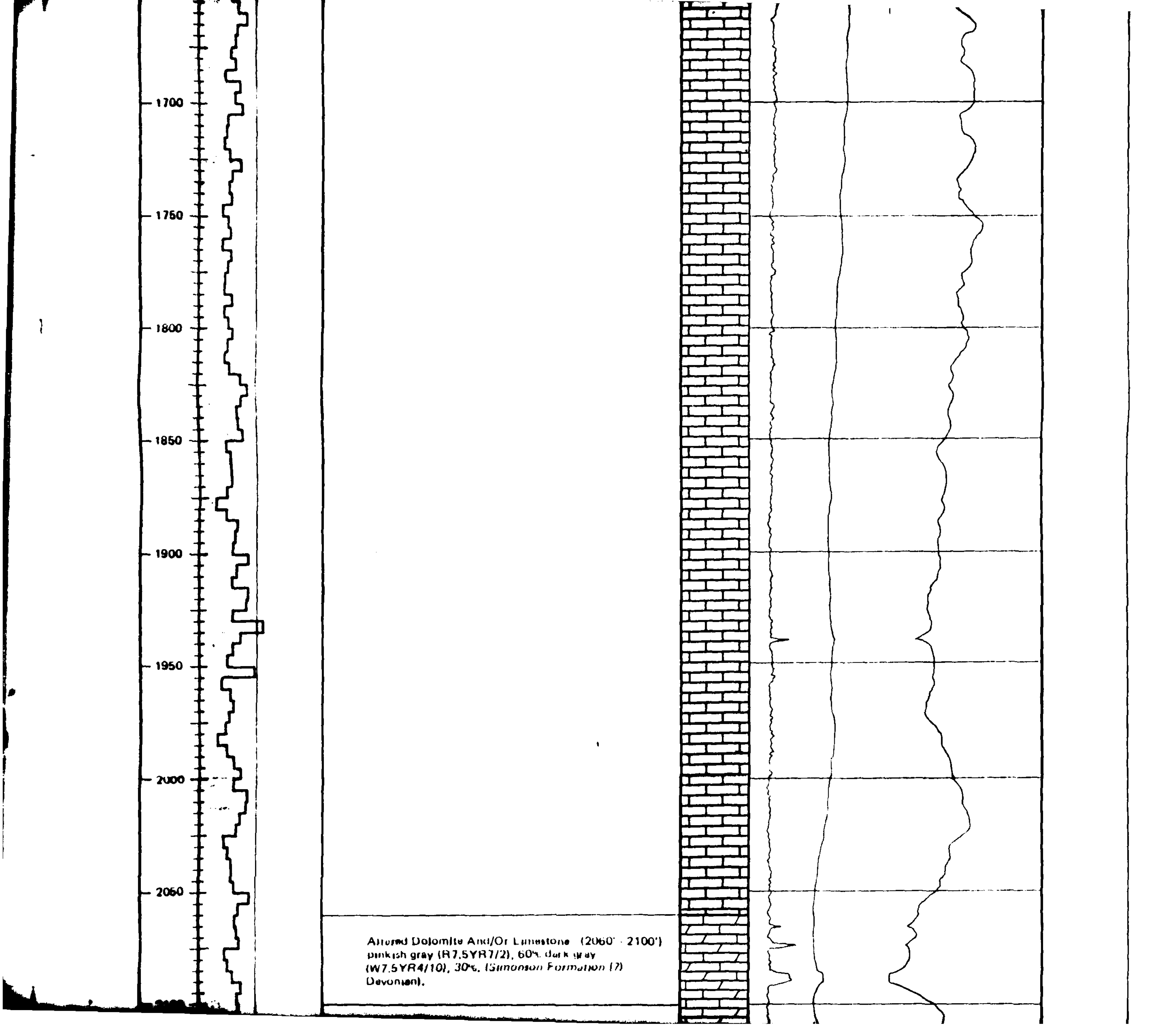
200
250
300
350
400
450
500
550
600
(206' - 240')
no time
Tuff (196' 335') yellow (Y2.5YR7/6) 80%, mixed volcanics 20% (Mesozoic-Tertiary)
Sandstone And Limestone - (335' - 360') weak red (R10R5/4), interbedded.
Limestone (360' 410'), weak red (R10R4/3), tuff and calcite present. (Guilmette Formation (?), Devonian)
Dolomite (410' 680') reddish gray (R5YR5/2), 95%, calcite present, 5% (Guilmette Formation(?), Devonian).
347'
10" I.D casing grouted in place
8" I.D casing, Casing



550
600
650
700
750
800
850
900
950
(670' - 675') no time
(970' - 975') no time
Dolomite - (680' - 780') light reddish brown (R5YR6/3), 100%. (Guilmette Formation (?), Devonian)
Dolomite - (780' - 930') pinkish gray (R5YR6/2), 95%. 5% calcite. (Guilmette Formation (?), Devonian)
775'
935'
8" I.D. casing, Casing welded in hole
Static water level 853' Nov. 1980

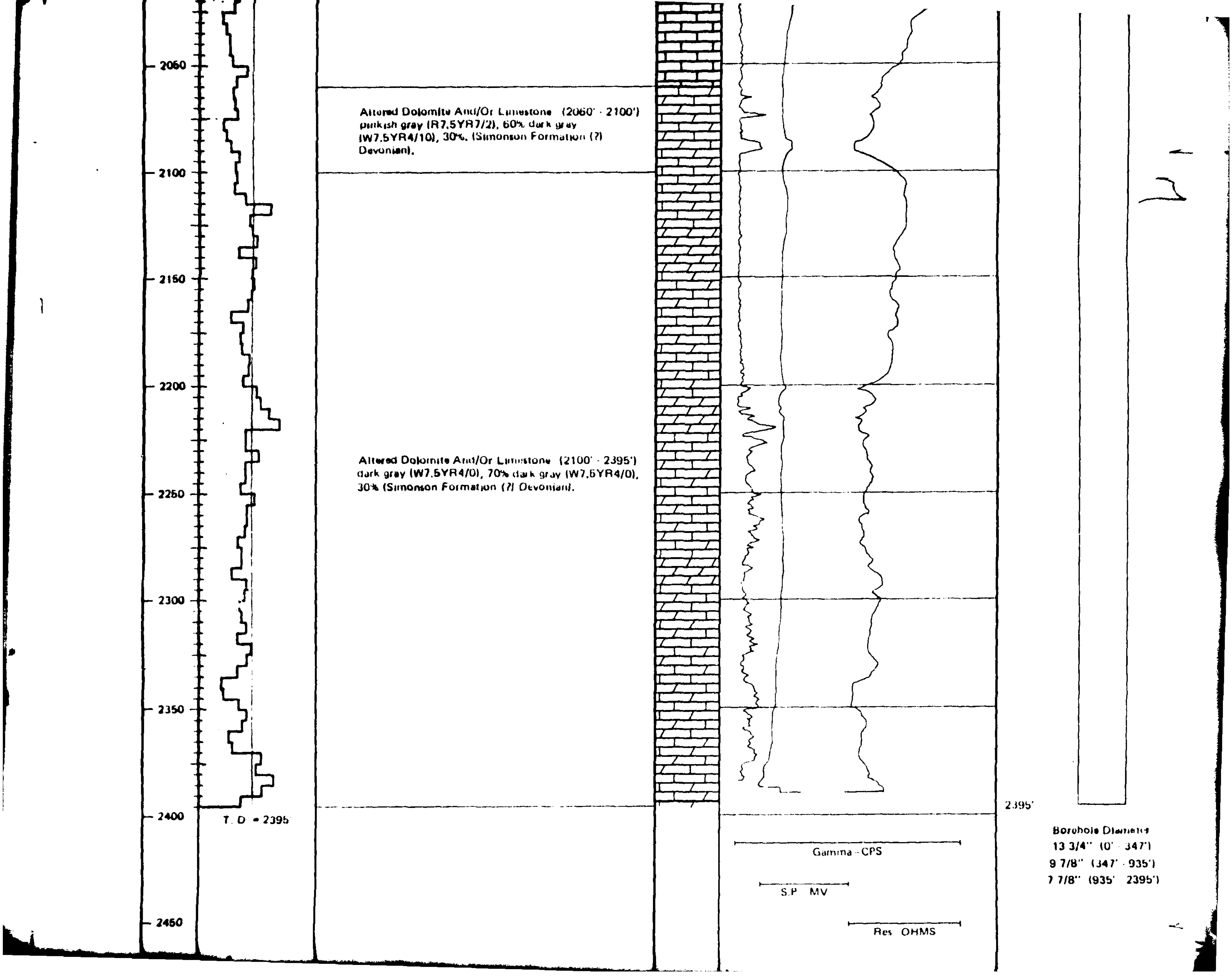

950
1000
1050
1100
1150
1200
1250
1300
1350
(970' - 976')
no time
Altered Limestone - (930' - 1140') pinkish white (W5YR8/2), 60%; limestone, dark reddish gray (R5YR4/2), 40%. (Guilmette Formation (?), Devonian).
935'

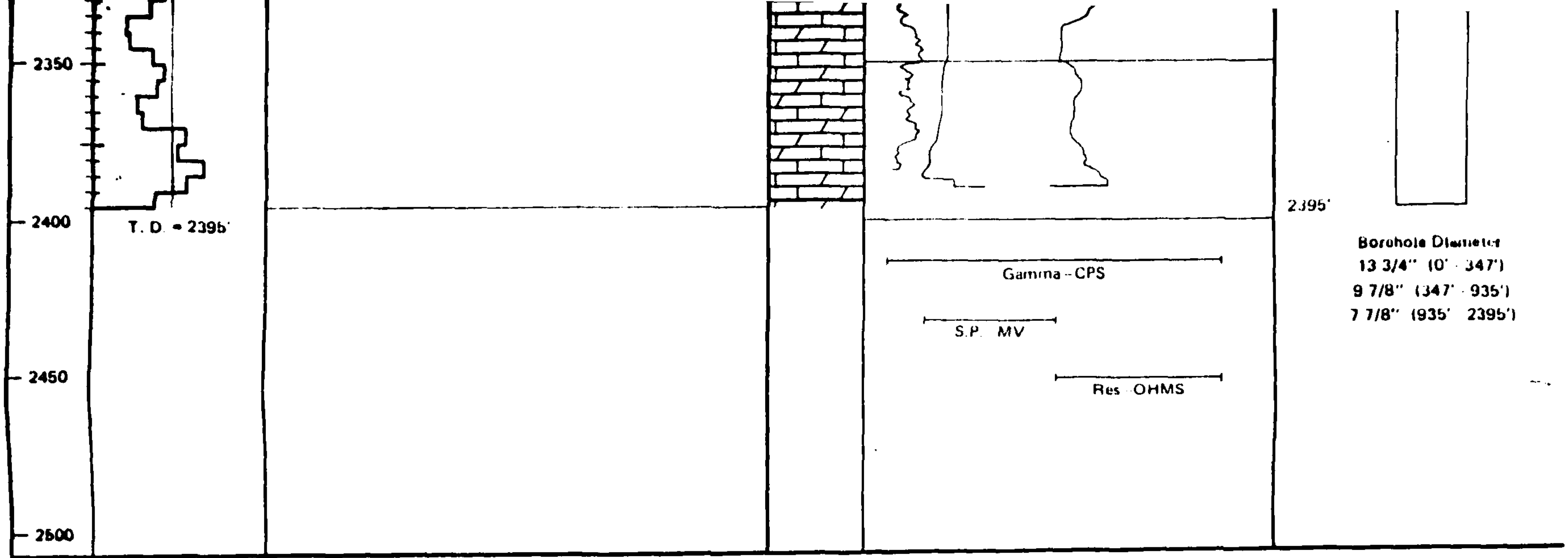

1300
1350
1400
1450
1500
1550
1600
1650
1700
Altered Limestone - (1140' 2060') pinkish white (W5YR8/2), 60%, limestone, dark reddish gray (R5YR4/2) and yellowish red (R5YR6/6), 40%. (Guilmette Formation (?) Devonian).



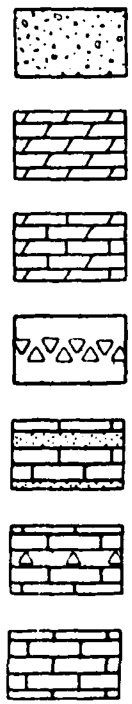
1700
1750
1800
1850
1900
1950
2000
2050
Altered Dolomite And/Or Limestone (2060' - 2100') pinkish gray (R7.5YR7/2), 60% dark gray (W7.5YR4/10), 30%, (Simonson Formation (?) Devonian).

6


2050
2100
2150
2200
2250
2300
2350
2400
2450
T. D = 2395
Altered Dolomite And/Or Limestone (2060' - 2100') pinkish gray (R7.5YR7/2), 60% dark gray (W7.5YR4/10), 30%. (Simonson Formation (?) Devonian).
Altered Dolomite And/Or Limestone (2100' - 2395') dark gray (W7.5YR4/0), 70% dark gray (W7.5YR4/0), 30% (Simonson Formation (?) Devonian).
Gamma - CPS
S.P MV
Res OHMS
2395'
Borehole Diameter
13 3/4" (0' - 347')
9 7/8" (347' - 935')
7 7/8" (935' - 2395')



LITHOLOGIC SYMBOLS



WELL DESIGN

Ertec
The Earth Technology Corporation

... INVESTIGATI...
DEPA... ...F THE AIR F...
B.../AFRCE MX

LITHOLOGIC ... AN...
COMPLETION SUMMARY - ...
VALLEY-CARBONATE TEST

FILMED

05-8